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No.

IN THE
SUPREME COURT OF THE UNITED STATES

October Term, 1983

RAILROAD DYNAMICS, INC.,
Petitioner

v.

A. STUCKI COMPANY,
Respondent

APPENDIX OF PATENTS AND ENGINEERING DRAWINGS TO THE PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE FEDERAL CIRCUIT

Alan S. Nadel
Ronald L. Panitch
PANITCH, SCHWARZE,
JACOBS & NADEL
Suite 1400
2000 Market Street
Philadelphia, PA 19103
(215) 567-2020

Edward H. Rubenstone
812 N. Fairway Road
Glenside, PA 19038
(215) 887-9786
Attorneys for Petitioner

PACKARD PRESS / LEGAL DIVISION, 10th & SPRING GARDEN STREETS, PHILA., PA. 19123 (215) 236-2000

EDITOR'S NOTE

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United States Patent [19]

Wiebe

[11] **3,837,292**

[45] **Sept. 24, 1974**

[54] **HYDRAULIC TRUCK SNUBBER**

[76] Inventor: **Donald Wiebe**, R.D. No. 3, Sewickley, Pa. 15143

[22] Filed: **Apr. 15, 1971**

[21] Appl. No.: **134,126**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 857,274, Aug. 22, 1969, Pat. No. 3,595,350, which is a continuation-in-part of Ser. No. 709,142, Feb. 28, 1968, abandoned.

[52] **U.S. Cl.** ..... **105/197 DH**, 188/321, 267/4, 267/8 R, 267/127

[51] **Int. Cl.** **B61f 5/12**, F16f 9/06, F16f 9/32

[58] **Field of Search** ..... 105/197 R, 197 D, 197 DB, 105/199 CB, 199 R, 197 DH; 188/321; 267/4, 8 R, 127

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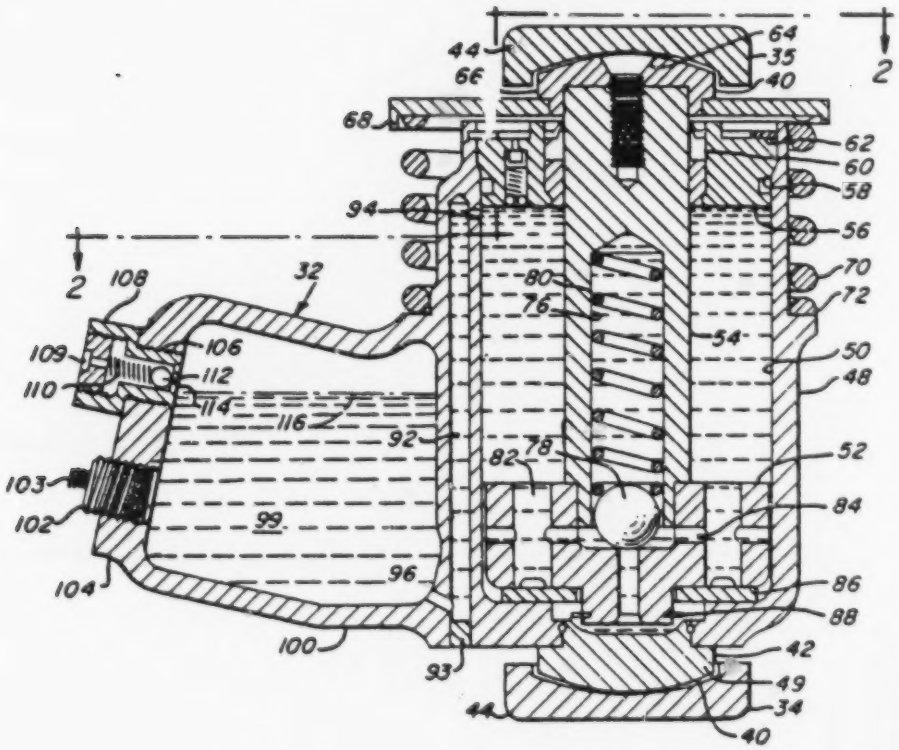
3,626,864	12/1971	Wiebe	105/197 D X

Primary Examiner—M. Henson Wood, Jr.
Assistant Examiner—Howard Beltran
Attorney, Agent, or Firm—Howard E. Sandler

[57] **ABSTRACT**

A hydraulic snubber device for railroad car trucks to be interposed between a bolster end and side frame member. This device being of minimum height for a given useful stroke because ullage volume is provided in a reservoir outside the snubber cylinder.

10 Claims, 9 Drawing Figures



PLAINTIFF'S EXHIBIT 2

PATENTED SEP 24 1974

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FIG. 1

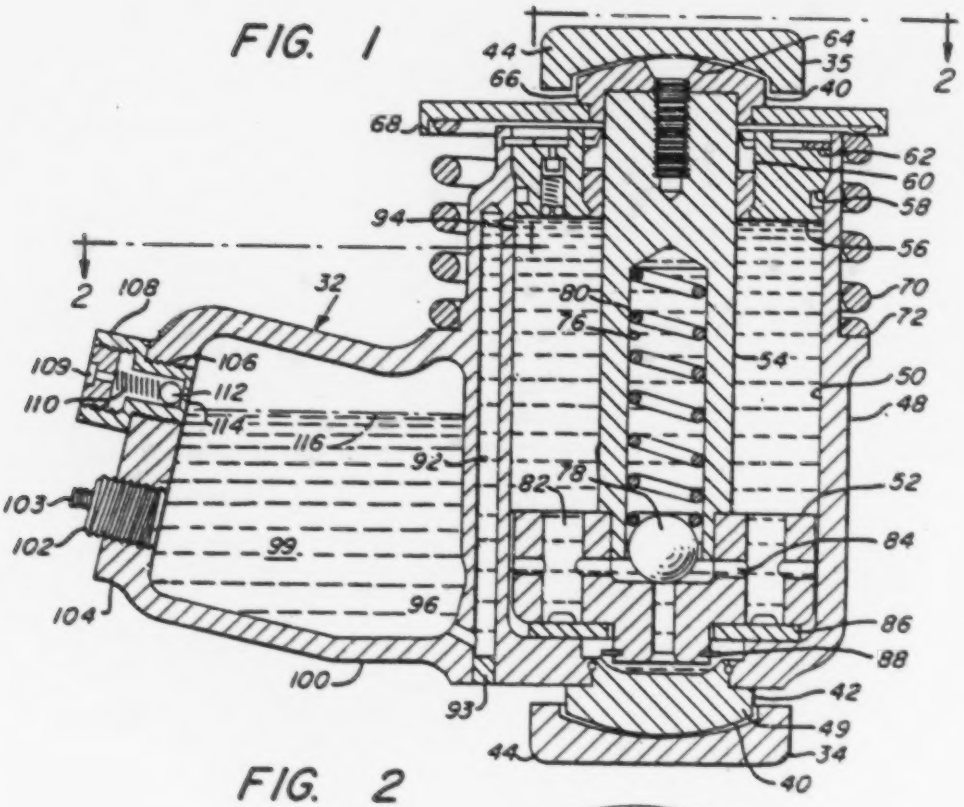
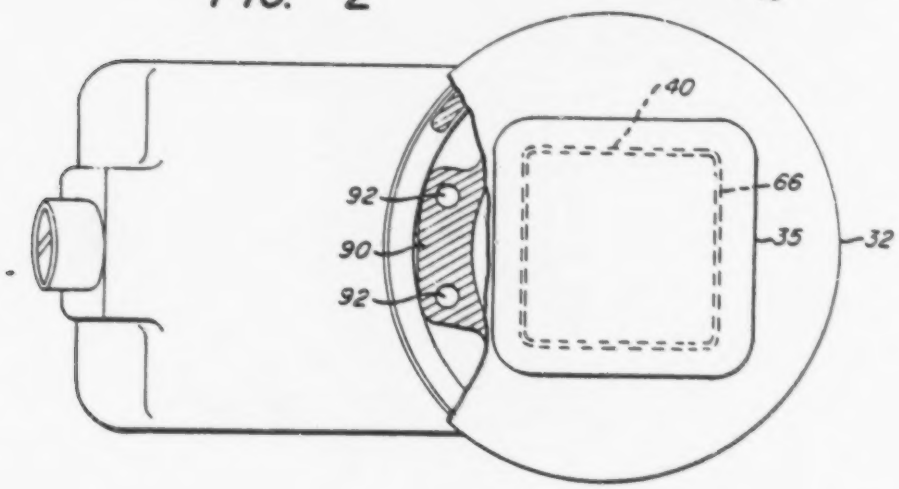


FIG. 2



INVENTOR
DONALD WIEBE

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FIG. 9

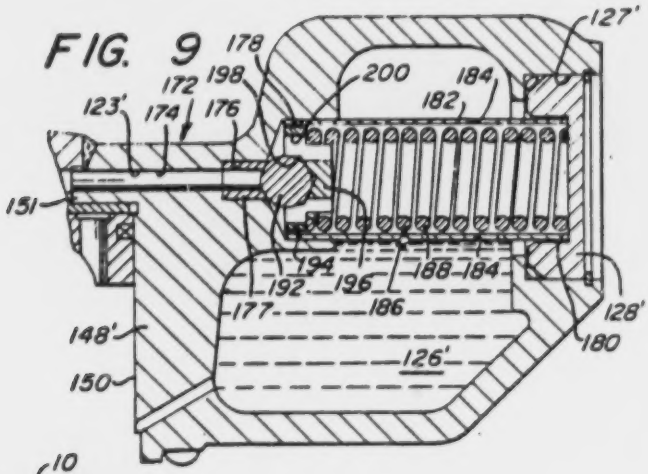


FIG. 3

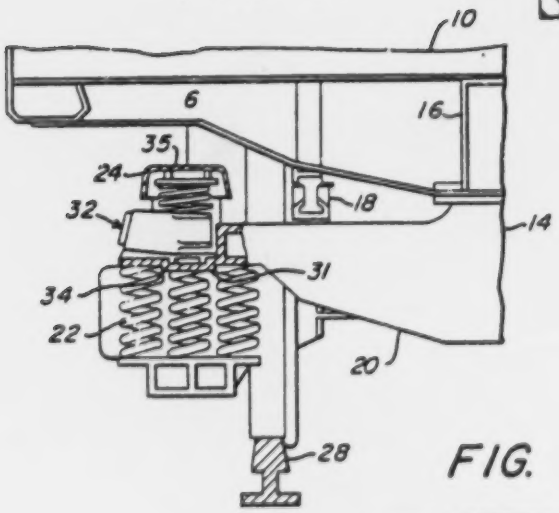
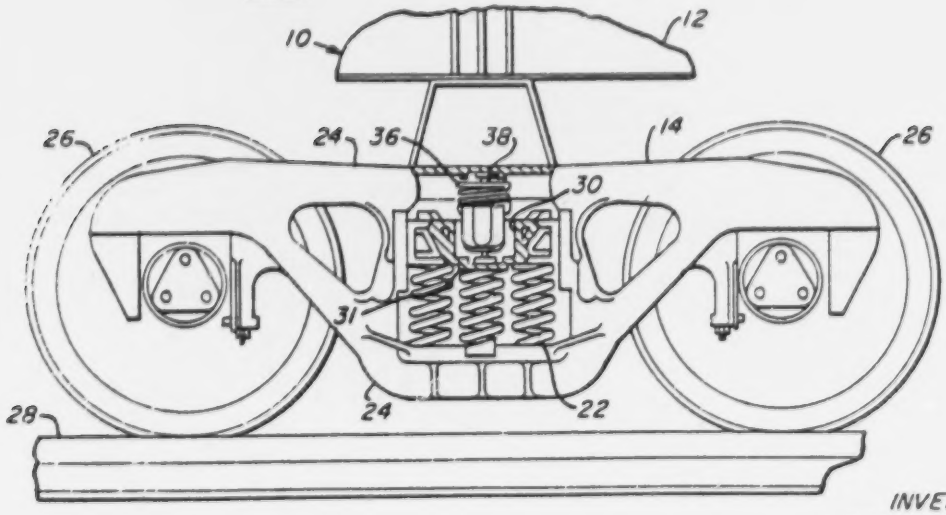


FIG. 4



INVENTOR
DONALD WIEBE

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FIG. 5

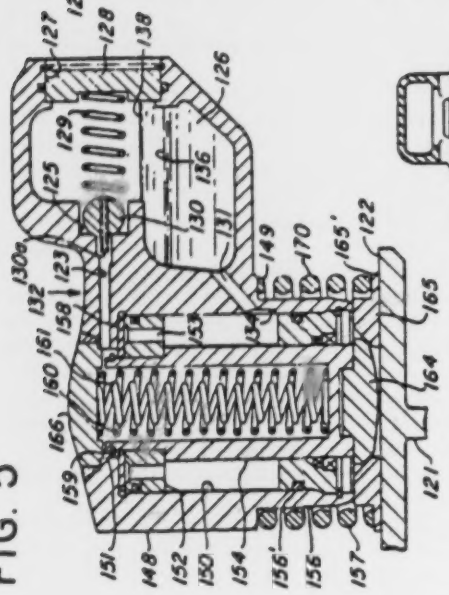


FIG. 6

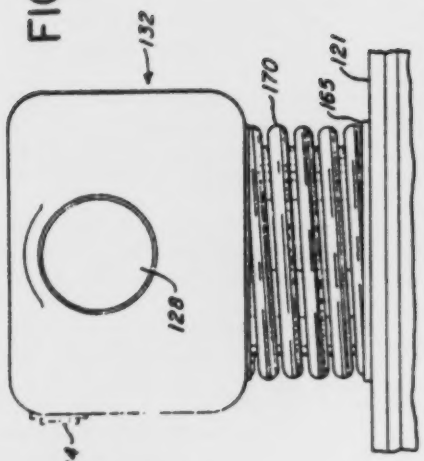


FIG. 7

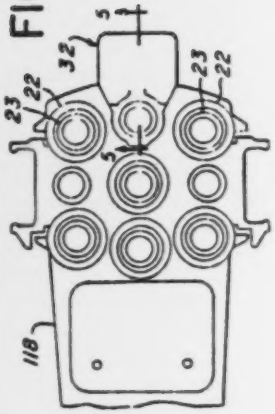
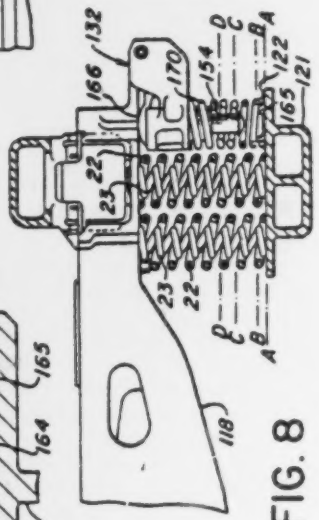


FIG. 8



HYDRAULIC TRUCK SNUBBER

This application is a continuation-in-part of U.S. Pat. application Ser. No. 857,274, filed Aug. 22, 1969, now U.S. Pat. No. 3,595,350 which in turn is a continuation-in-part of U.S. Pat. application Ser. No. 709,142 filed Feb. 28, 1968, now abandoned.

The structure of this invention provides an external reservoir for hydraulic fluid which cooperates with the snubber cylinder space to virtually eliminate the dead space or ullage volume normally necessary, at the top, within a closed hydraulic cylinder to provide for the volume of hydraulic liquid displaced by the piston rod when the piston is forced to the bottom of the cylinder. In the structure of this invention the external reservoir provides the ullage volume necessary for the operation of the piston within the cylinder so that the cylinder can be designed to operate effectively over its full stroke, with practically zero ullage volume within the cylinder.

It is therefore an object of this invention to provide a new and improved side frame snubber designed to operate at full efficiency as an energy absorbing structure throughout the full stroke of the piston within the cylinder.

These and other objects and advantages of the snubber of this invention will become more readily apparent upon consideration of the following description and drawings in which:

FIG. 1 is a median sectional view of a snubber constructed according to the principles of this invention;

FIG. 2 is a partially sectional view of the snubber of FIG. 1 taken substantially on line 2—2 of FIG. 1;

FIG. 3 is a fragmentary partially sectional and elevational view of a freight car body and truck incorporating the snubber of this invention;

FIG. 4 is a side elevational, partially sectional view of the structures shown in FIG. 3;

FIG. 5 is a sectional view of another snubber constructed according to the principles of this invention; taken substantially on line 5—5 of FIG. 6;

FIG. 6 is an end elevational view of the snubber of FIG. 5;

FIG. 7 is a top plan schematic view of a spring group incorporating the snubber of FIG. 5;

FIG. 8 is a fragmentary partially sectional schematic view of the spring group of FIG. 7;

FIG. 9 is a partial sectional view of still another snubber constructed according to the principles of this invention and similar to the embodiment shown in FIG. 5.

Referring now to the drawings, FIG. 4 shows a fragmentary portion of a railway car 10 comprising a freight car body 12 supported by a four-wheel truck (only one half being shown) by way of a center plate 16 and side bearings 18 (see FIG. 3) cooperating with a bolster 20, mounted upon two sets of compression type springs 22, mounted in a pair of side frames 24 each supported by a pair of suitably journaled wheels 26 resting upon a pair of tracks 28 all as well known to those familiar with the field of railway car design.

The bolster 20 is of conventional design except that an opening 30 has been formed in each end portion of the bolster 20 to provide space for mounting a snubber 32 constructed according to the principles of this invention. The bottom surface of the open space 30 has a downwardly recessed portion 31 positioned centrally

of the opening 30 to accept and maintain the positioning of a substantially square cup shaped lower mounting element 34 hereinafter more fully described (see FIG. 1).

Side frame 24 is likewise of conventional construction except that at a central portion of the underside of its top member there is formed a downwardly depending ring element 36 having a blind central opening of substantially square outline therein to accept, and maintain the positioning of a generally inverted cup shaped upper mounting element 35 (hereinafter more fully described, see FIG. 1) with the snubber 32 extending between the lower mounting element 34 and the upper mounting element 35 cooperating to form a pair of bearing surfaces for the reaction imposed upon the snubber 32 by the bolster 20 and the side frame 24 as hereinafter more fully set forth.

As shown in FIGS. 3 and 4 the mounting elements 34 and 35, respectively, are of generally rectangular or square outline with a concave internal depression 40 of partial cylindrical form in each mounting element 34, 35. The cylinder axis of each depression 40 is contained in a plane normal to the outer surface of the respective mounting element 34, 35 and also normal to opposite sides of the square outline of the respective mounting element.

Seated in and cooperating with the depression 40 of the bottom mounting element 34 is a snubber bottom member 42 of generally rectangular or square outline having a convex partially cylindrical bottom surface 44 and having its cylinder axis in the same plane as that described for the concave surface of the depression 40.

The snubber 32 comprises a generally hollow cylindrical body member 48 having a central opening 49 in the bottom thereof, closely receiving and retaining in fluid tight relationship an upwardly extending cylindrical portion of the snubber bottom member 42 to form a closed bottom for the internal cylindrical surface 50 of the body member 48 wherein a suitable piston 52 is axially reciprocable. The piston 52 is rigidly secured to and movable by an upwardly extending cylindrical piston rod member 54 which extends upwardly throughout the axial length of the body member 48, through and beyond an annular cylinder closure member 56 mated to and closely received by the cylindrical surface 50 and maintained in fluid tight relationship with the cylinder 50 and the exterior of the piston rod 54 by suitable sealing members such as O rings 58 and U-type seals 60, respectively, or other suitable sealing elements. A lock ring 62, or other suitable retaining means, secures the cylinder closure member 56 within the cylindrical surface 50 while the piston rod 54 is maintained in slidable relationship with the central bore in the cylinder closure member 56 as is well known in the hydraulic cylinder art. Mounted on the upper end of the piston rod 54 and rigidly secured thereto as by one or more threaded retaining elements such as a cap screw 64 is an inverted cup-shaped snubber top member 66 having a convex partial cylindrical reaction surface 44 thereon of the same character and radius as the reaction surface 44 of the snubber bottom member 42 herein before described.

Abuttingly engaged with a lower surface of the exterior of the snubber top member 66 is a spring retaining cap member 68 rigidly secured by the snubber top member 66 to travel with the piston rod 54 in axial reciprocation. A cylindrical compression type spring 70

is engaged between the underside of the cap member 68 and an external shoulder 72 formed on the outer surface of the cylindrical body member 48 and is sufficiently compressed so that in the absence of other forces the spring 70 will extend the piston rod 54 from the body member 48 until the piston 52 contacts the bottom of the cylinder closure member 56 in a manner common to single acting hydraulic cylinders.

The piston 52 and the piston rod 54 are similar to that described and shown in the above-cited copending application in that the piston 52 is provided with a central bore 74 which communicates with a blind central bore 76 in the piston rod 54 when the pressure on the bottom of the piston 52 is great enough to raise a ball valve 78 biased against the upper end of the central bore 74 by a spring 80 captively mounted in a compressed condition within the blind bore 76. The piston 52 is also provided with a plurality of bores 82 extending therethrough from its bottom to its top surface and communicating with the central bore 74 by respective horizontal passages 84. In the position shown in FIG. 1 the bores 82 are closed by a flat ring valve 86 covering the bottom ends of the bores 82 whenever pressure below the piston is substantially greater than pressure above the piston due to downward motion of the piston 52 within the cylinder 50. The valve 86 is free to move downwardly with respect to the bottom of the piston 52 a limited distance and prevented from moving farther in the axial direction with respect to the piston 52 by a suitable snap ring 88 mounted on a downwardly extending cylindrical portion of the piston 52 as described in the above cited copending application.

The body member 48 has a thick wall portion 90 (see FIG. 2) extending from the bottom of the body member 48 up to an area slightly above the bottom surface of the cylinder closure member 56 (as best seen in FIG. 1). Within the wall portion 90 is formed a pair of passageways such as elongated bores 92 having axes parallel to the axis of the cylinder 50 and extending within the wall portion 90 from the bottom of the body member 48 nearly to the top of the thick portion 90 at least as far up as the bottom surface of the cylinder closure member 56. At a point just below the bottom surface of the cylinder closure member 56 horizontal passageways 94 communicate between the interior of the cylinder 50 and the passageways 92, respectively. Similar substantially horizontal passageways 96 communicate between lower end portions of the bores 92 and the interior space 99 of a generally rectangular, substantially horizontally extending reservoir or hollow tank element 100 formed as a lateral extension of the body member 48 secured to or formed integral with the lower half of the body member 48. The bottom ends of the bores 92 are sealed by plugs 93 so that the interior space 99 communicates with the cylinder 50 through the passageways 96, 92 and 94 with the result that hydraulic liquid within the cylinder 50 can be displaced outwardly into the interior space 99 of the tank element 100 or caused to flow in the opposite direction as hereinafter more fully described.

The tank element 100 is provided with a threaded hollow plug 102 suitably threadedly engaged in a filler opening in the lower portion of an outer end member 104 of the tank element 100 and having a suitable check valved connection 103 thereon to provide for filling the interior of the tank element 100 with liquid by the application of a suitable pressurized fluid conducting element (not shown) to the valve fitting 103 in a well known manner. A second threaded bore 106 communicates with an upper portion of the interior of the tank element 100 and has threadedly engaged therein an adjustable valve 108 provided with an internally threaded stepped bore 114 in which is engaged an adjusting element 109 captively securing a spring 110 biasing a ball valve 112 into engagement with a smaller portion of the bore 114 which communicates between the upper portion of the inner chamber of the tank element 100 and the ambient atmosphere. The adjusting element 109 is suitably adjusted so that the ball valve 112 will remain seated and prevent communication between the interior of the tank element 100 and the ambient atmosphere until the pressure within the interior space 99 of tank element 100 exceeds that of the ambient atmosphere by at least a pre-selected amount, preferably approximately 2–5 atmospheres in the present embodiment.

OPERATION

With the above described snubber 32 fully assembled and in the upright position as shown in FIG. 1 but with the piston rod 54 fully extended and the piston 52 abutting the bottom surface of the cylinder head 56 a suitable liquid having the requisite physical and chemical characteristics for use as a pressure transfer medium within an hydraulic cylinder is pumped into the space 99 through the connection 103 until compression of the air within the space 99, the bores 92 and the cylinder 50 produces a pressure of approximately 5 atmospheres. Under such pressure the air within the communicating spaces 99, 92 and 50 will be compressed to approximately one fifth its original volume with approximately four fifths of the tank space 99 and the cylinder 50 being filled with liquid so that the liquid in the tank reaches a level approximately that indicated by a horizontal line 116 across the space 99 (see FIG. 1). The stepped bore 114 is suitably located so that its inner end portion communicating with the space 99 determines the level 116 so that liquid flows out of the bore 114 when the tank is being filled and whenever the pressure within the space 99 overcomes the spring 110 at the pressure for which the valve 108 has been set. The level 116 must be far enough above the level of bores 96 so that the bores 96 are always submerged under operating conditions.

When the piston rod 54 is pushed downwardly into the cylinder 50 the piston 52 travels downwardly with the valve 86 open as long as the downward motion of the piston 52 is slow enough to avoid substantial pressure differential between the upper and lower sides of the piston 52 so that the liquid below the piston can flow upwardly through the bores 82 into the space within the cylinder 50 above the piston 52. During the inward motion of the piston rod 54 liquid and air must be displaced from the cylinder 50 because of the volume occupied by the increased portion of the piston rod 54 within the cylinder 50 (displacement volume). With a newly filled snubber 32 approximately one fifth of the space within the cylinder 50 will be occupied by air which, because of gravitational effect, will be accumulated at the top of the cylinder 50 so that displacement of the piston rod volume will increase the air pressure within the cylinder and force air in the top of the cylinder 50 to travel outwardly through the passageways 94, downwardly through the bores 92, horizon-

tally outwardly through the passages 96 into the space 99 where the air will rise in the form of bubbles through the liquid in the space 99 to become part of the trapped air volume above the level 116 within the space 99.

When the piston rod 54 again moves upwardly within the cylinder 50, removal of a portion of the volume of the rod 54 from the interior of cylinder 50 provides space for more oil within the cylinder 50 and this amount of liquid will be supplied by liquid from the space 99 flowing through the passages 96, upwardly through the bores 92, and horizontally inwardly through the passages 94, into the cylinder 50. Successive up and down motions of the piston rod 54 will thus cause an exchange of air in the cylinder 50 and oil in the space 99 until the cylinder 50 is completely filled with oil.

It is to be noted that the combined cross sectional area of the bores 92 or equivalent passageway means must be large enough to allow free flow of liquid therethrough (no orifice effect). Furthermore the total volume of such passageway or bores 92 must be small enough so that normal rod movement into cylinder 50 to within an inch of fully closed will displace more than enough liquid to completely fill the bores 92. Or vice versa this amount of liquid must flow into the cylinder during rod extension to originally displace the air and thereafter to keep the cylinder full of liquid at all times.

It is to be appreciated that without the tank element 100 and the communicating passageways as hereinabove described it has always been necessary in prior art snubbers to provide at least some liquid free space or ullage volume at the top of the cylinder so that displacement of liquid by the piston rod entering the cylinder would not cause unwanted overpressuring of the cylinder 50 with resultant damage to the sealing elements and unacceptable loss of the hydraulic fluid.

Because of the transfer of ullage volume in the present invention from the top of the cylinder 50 to the top of the space 99 the snubber 32 of this invention is usable throughout the total length of piston stroke since the piston is always completely covered by and filled with the hydraulic liquid and no space need be left empty at the top of the cylinder as was necessary in prior art snubbers.

The minimum volume unfilled by liquid within the space 99 above the level 116 (hereinafter the ullage volume) should not be less than approximately 150 percent of the volume of that portion of the piston rod which moves into and out of the cylinder 50 below the cylinder head 56 (hereinafter the displacement volume), to avoid overpressuring the snubber at full stroke, and to avoid preventing the flow of the air which has been pressurized in the top of the cylinder 50 through the passageways 94 and 96 and the bores 92. This ullage volume in the reservoir is preferably three to four times the volume of the bores 92 and the communicating passageways 94 and 96 with the passageways of a diameter to allow free flow of liquid with very little pressure drop. This ratio of volumes has been found to be great enough to give free volume above the level 116 sufficient to permit displacement of the column of liquid in the bores 92 to provide for purging of air from the bores 92 into the space 99. Thus the volume of the bores 92 must always be less than one half the total piston rod displacement volume so that flow of air from the bores 92 into the space 99 will not be prevented by compressibility of the air.

Operation of the snubber 32 of this invention is similar to that described for the snubber of my copending U.S. Pat. application Ser. No. 801,884, now U.S. Pat. No. 3,626,864 except for the flow of liquid into and out of the cylinder 50 and the space 99 as hereinabove described. Such operation of course includes the "dead band operation" and the free flow of oil through the piston 52 during slow downward movement of the piston 52 within the cylinder 50 as well as the high pressure energy absorbing flow of oil through the passageway 74 in the piston 52 past the ball valve 78 after compression of spring 80, during rapid downward movement of the piston 52 which closes the valve 86, all as described with relation to the side frame snubber of the above cited application.

Referring again to the drawings, FIGS. 5 through 8 show another embodiment of a reservoir type snubber 132 constructed according to the principles of this invention and quite similar to the reservoir type snubber 32 of FIGS. 1 and 2 excepting the snubber 132 of this embodiment is a spring group snubber, i.e., the snubber 132 is designed to replace one of the springs 22 of the standard spring group interposed between a standard bolster 118 and a standard side frame 120 in the truck of a railway freight car such as that indicated at 10 in FIG. 3.

The application of the snubber 132 is very similar to that described and illustrated in my copending U.S. Pat. application Ser. No. 801,884 filed Oct. 23, 1968 which also illustrates a spring group snubber. It is of course obvious that the spring group snubber type has the advantage of being applicable to a standard side frame and standard bolster with a minimum of reconstruction thus saving the expenses of designing and building special bolsters and side frames with the attendant expenses of special parts to be stocked and accounted for.

As best seen in FIG. 5 the snubber 132 comprises a body member 148 which provides a hollow cylindrical surface 150 in which a piston 152 is reciprocated by action of a piston rod member 154 which extends downwardly from the piston 152 through a closure member 156 rigidly secured in the lower open end of the cylinder 150 as by snap ring 157 and maintained in fluid tight relationship with the cylinder 150 by resilient members such as O-rings 156' or the like.

The top end of the cylinder 150 is permanently closed by a top member 166 secured in a stepped portion of the cylinder 150 as by welding. The top member 166 is shown as having an upwardly convex surface contacting the underside of the bolster end in place of the conventional spring as best seen in FIG. 8. It is to be seen that the snubber 132 replaces any one of the three outside springs 22 of the truck spring group along with one of the inner spring 23 shown in FIG. 8 to be coaxial with and cooperating with the outer springs 22 in a manner well known in railroad circles.

The bottom end of the piston rod 154 is provided with a solid bottom member 164 having a downwardly convex surface and a bottom edge chamfer adapted to be received in a mounting ring 165 secured or trapped in place between a spring 170 and the uppersurface 122 of the side frame bottom member 121. The body support spring 170 surrounds a reduced diameter outside surface portion of the body member 148 and is in-

terposed between an annular shoulder 149 of the body member 148 and the shouldered top surface 165' of the mounting ring 165. As best seen in FIG. 8 the body spring 170 in this position supports the body member 148 in all relative positions of the bolster and side frame and holds the mounting ring 165 in place.

The internal workings of the snubber 132 are quite similar to those of the snubber 32 of the first embodiment with the difference that the snubber 132 is in many respects a top to bottom reversal of the snubber 32. The piston 152 is provided with a ring of vertical through bores 153 having axes parallel to the axis of the piston rod 154 and circumferentially spaced about the axis of the piston 152 and radially equidistant therefrom. Covering the top ends of the bores 153 is an annular disc valve 158 loosely slidable upon a through piston extension portion of the piston rod 154 and prevented from displacement off this extended portion by means such as the snap ring 159 which nevertheless allows the valve 158 to move far enough away from the bores 153 to allow a free flow of hydraulic fluid therethrough. The piston rod 154 is of course sealingly slidable through the closure member 156 and the piston and piston rod 154 are biased downwardly by coaxial double compression springs 160 and 161 outer and inner, respectively. The piston 152 is movable upwardly in the cylinder 150 until it comes in contact with the shoulder formed by the transition from the full diameter portion of the cylinder 150 to a smaller diameter portion 151 and this smaller diameter portion 151 extends upwardly to the bottom side of the top member 166 forming a small diameter top cylinder portion at the extreme upper end of the cylinder 150. This small diameter portion 151 communicates with a passageway 123 extending substantially horizontally to the right as seen in FIG. 5 to an enlarged passageway portion 125 which in turn communicates with the cavity of a reservoir 126 formed in a horizontally extending portion of the body member 148. The bore 123 must be large enough to provide for free flow of hydraulic liquid (no orifice effect) probably not less than ⅛ inch in diameter. The reservoir 126 is provided with a large horizontal bore 127 coaxial with the passageways 123 and 125 through the outer wall of the reservoir 126. Rigidly secured within the bore 127 is a closure member 128 provided with a snap ring and O-ring to maintain the fluid tight relationship of the closure member 128 with the bore 127. The closure member 128 forms a seat for a valve spring 129 interposed between the inner surface of the closure member 128 and a spherical valve 130 which is positioned in the portion 125 to close off the reservoir end of the passageway 123 in a well known manner. An orifice 130*a* is shown as a bore through valve 130 coaxial with the bore 123 and of a size to provide for viscous flow of hydraulic liquid under pressures ranging from a few atmospheres to whatever pressure will unseat the valve 130 probably around 140 atmospheres.

At this point it is well to note that the total volume of bore 123 plus the clearance volume within cylinder portion 151 with the piston at maximum height must be less than 1 percent of the piston displacement volume to provide for progressive clearing of air from the cylinder 150 to be replaced with liquid.

The reservoir 126 also communicates with the cylinder 150 through a passageway 131 extending from a lower portion of the reservoir 126 to a lower portion of the cylinder 150 wherein the passageway 131 is provided with a downwardly extending cylinder relief portion 134 extending downwardly from the passageway 131 in the wall of the cylinder 150 to a point upwardly adjacent the upper side of the closure member 156 for a purpose to be made clear.

When the snubber 132 is assembled with the body spring 170 it extends between the side frame bottom member 121 and the bolster bottom surface 168 as seen in FIG. 8. Also as seen in FIG. 8 the top surface 122 of the side frame bottom member 121 will, when the bolster and side frame are assembled but not supporting a car, be at a level indicated by the line A—A relative to the bolster 118. When a car body is placed on the truck of which this side frame 120 and bolster 118 are a part, the relative position of the top surface 122 of the side frame bottom member 121 will be at a position, relative to bolster 118, represented by the horizontal line B—B. This would be the unloaded car position and it is well illustrated that in this position there would be little or no action by the snubber 132 even if the car should bounce somewhat or rock slightly as it was being propelled over the rails. The next horizontal line upward from line B—B namely line C—C represents the normal position of the top surface 122, relative to bolster 118, with a loaded car and it is to be seen that at this time the hitherto fully downwardly extended piston rod 154 will be forced upwardly into the cylinder 150 by the slight amount represented by the height of the line C—C above the downwardmost positioning of the bottom member 164 in FIG. 5. The topmost of the horizontal lines namely D—D represents the position of the top surface 122 relative to the bolster 118 when the spring group has been completely collapsed into solid condition. At this positioning the piston 152 will be very nearly in contact with the shoulder at the top of the cylinder 150 while the mounting ring 165 is almost in contact with the bottom edge of the body member 148 with the parts almost in the position shown in FIG. 6.

By using a plug 124 in the forward wall of reservoir 126 (see FIG. 6) the inside of the body member 148 of the snubber 132 is properly filled with hydraulic liquid such as oil or other suitable liquid so that when in operation the level of liquid in the reservoir 126 will vary between a low level 136 shown as a broken line in FIG. 5 when the piston is at the bottom of the cylinder 150 and the rod 154 completely extended to the position shown in FIG. 8, and rising to the level shown as line 138 in FIG. 5 when the piston 152 has been pushed to the top of the stroke approximately as seen in FIG. 5.

OPERATION

In beginning the operation of a new snubber 132 there will likely be air trapped in the cylinder 150 and if the piston rod 154 is completely extended as seen in FIG. 8 all of the air in the cylinder 150 will be above the piston 152 by simple gravitational accumulation. At this time the level of liquid in the reservoir 126 will be at some unknown point higher than the level 136 because of the presence of air in the cylinder 150. As the piston 152 rises cyclically in the cylinder 150 because of the motion of the car, air above the piston 152 will be pushed through the small cylinder portion 151, ahead of oil present above the piston, into the passageway 123 and through orifice 130*a* or around the valve

130 into the upper regions of the reservoir 126. Thus, with the rod 154 being cyclically pushed into the cylinder 150 the level of the liquid in the reservoir 126 will gradually fall during the first few strokes as more and more air is gravitationally accumulated at the top of the cylinder 150 in the portion 151 and forced outward through the passageway 123. After a reasonable number of piston excursions upwardly and downwardly in the cylinder 150 the cylinder 150 and the bores 153 will be essentially completely filled with liquid with very little if any air remaining at the top of the small bore portion 151 or in the passageway 123.

The snubber 132 is now ready for normal operation very similar to that described for the spring group snubber of the above copending application or for the embodiment of FIGS. 1 through 4 of this application. As hereinbefore mentioned, the limit of extension of the piston rod 154 precludes any action of the snubber 132 with a light car so that true operation of this device begins with a loaded car being moved along a railway and responding to the variations in track height in a well known manner. With the car standing level or traveling on a level track the normal position of the piston 152 will be slightly raised from the upper surface of the closure 156 with the liquid in reservoir 126 at a level slightly above the line 136 since a small amount of the piston rod 154 has been forced into the cylinder 150 displacing a small amount of liquid. As the car begins to rock a first motion could be the downward motion of the bolster 118 toward the side frame bottom member 121 forcing the piston 152 higher into the cylinder 150. This action would force liquid from the upper side of the piston through the small cylinder portion 151 and the passageway 123 through the orifice 130a or out under the spherical valve 130 against the force of the spring 129 concentrated on a very small area at the end of the bore 123. When flow of liquid from cylinder 150 is taking place only through the orifice 130a energy absorption will be of the viscous flow type. This type of flow will be significant only during relatively slow bolster movement with respect to the side frame. However, during more rapid and forceful bolster movement forced displacement of the liquid above the piston 152 through the narrow opening formed by the slightly displaced valve 130 provides constant pressure energy absorption in a manner well known to be valuable in preventing excessive spring action whether in railroad cars or other vehicles. As the piston 152 is forced into the cylinder 150 the piston rod 154 of course displaces more and more liquid from the cylinder 150 into the reservoir 126 raising the level of the liquid to the line 138. The volume represented by the difference in the height 136 and 138 is the ullage volume that would be the minimum necessary to leave free in the cylinder for displacement purposes if the cylinder were not connected to an outside reservoir such as the reservoir 126.

When the bolster 118 begins to rise with relation to the side frame 120 the piston travels downwardly in the cylinder 150 and is able to do so readily and rapidly because the annular valve 158 will lift off the surface of the piston 152 as soon as the pressure below the piston is even slightly greater than the pressure above the piston as it travels downwardly. Since the valve 130 acts as a check valve liquid will not come into the top of the cylinder 150 from the passageway 123, nor will air except a small amount by leakage or through the orifice 130a. But the liquid below the piston 152 will travel upwardly through the bores 153 to keep the top of the cylinder full of oil even though the piston is traveling downwardly and the piston rod 154 is being removed from the cylinder and displacing less and less liquid therefrom so that liquid must now travel downwardly through the passageway 131 into the cylinder 150 to maintain a full cylinder at all times. If a small amount of air should travel inwardly through the passageway 123 into the cylinder 151 it will remain at the top of the cylinder by gravitational accumulation and will be the first fluid expelled when the piston 152 is again forced inwardly of the cylinder 150.

With the snubber 132 there will be a small amount of non-absorbing or "dead band effect" for small rapid vibrations when the piston 152 moves rapidly downward forcing valve 158 off the top surface of piston 152 which then quickly moves upwardly a short distance before valve 158 has regained its seated position so that no piston displacement of liquid has occurred. For greater "dead band effect" a spring (not shown) can be interposed between valve 158 and piston 152 to prolong the above described action during less rapid or larger piston excursions.

It is further to be noted that the minimum volume of air space above the level 136 must be greater than one-fifth of the rod displacement volume to avoid overpressuring reservoir 126 and the minimum normal operating level would have a volume of oil between the top end of passageway 131 and level 138 at least equal to the total possible piston rod displacement to avoid adding air to cylinder 150 during the piston downstroke.

A further variation within the principles of this invention includes using a valve (not shown) similar to valve 130 but no orifice therein. Operation of such a snubber with no orifice would be limited to the constant pressure mode described above with a similar small "dead band effect" variable by use of a spring between piston 152 and valve 158 as earlier mentioned.

FIG. 9 is a partial cross-sectional view of still another embodiment of a snubber 172 constructed according to the principles of this invention. Snubber 172 is quite similar to the snubber 132 described hereinabove with the primary difference therebetween being in the passageway communication between the upper end of cylinder 150 and the reservoir 126' and the valving arrangement therebetween. Accordingly, like elements will be designated by the same reference numerals and similar elements will be designated by the same reference numerals primed. Inasmuch as snubber 172 is identical to snubber 132 as set forth hereinbefore with the exception of the differences described hereinabove, FIG. 9 illustrates only such differences with the understanding that reference is to be made to FIGS. 5–8 for identical and similar features and positioning.

In snubber 172, portion 151 of cylinder 150 communicates with a passageway 123' which extends substantially horizontally outwardly (to the right as seen in FIG. 13). Passageway 123' communicates between portion 151 and the cavity of a reservoir 126' formed in a horizontally extending portion of the body member 148' and comprises: an inner portion 174; an intermediate portion 176 which has a diameter thereof larger than the diameter of portion 173 and receives an annular seating sleeve 177 therewithin and an enlarged diameter outer portion 178. The inner diameter of sleeve

177 is shown as being equal to the diameter of passageway portion 174.

The reservoir 126' is provided with a large horizontal bore 127' which extends through the outer wall of the reservoir 126' and is coaxial with bore 123'. A closure member 128' is sealingly secured within bore 127'. Closure member 128' has a circular seating portion 180 extending outwardly from the innermost end thereof. Portion 180 is of an outer diameter thereof substantially equal to the diameter of passageway portion 178 and is coaxial therewith. A cylinder 182 is positioned intermediate portions 178 and 180 and the respective axial ends thereof are seated within the portions 178 and 180. The outer diameter of cylinder 182 is substantially equal to the outer diameter of portions 178 and 180. A plurality of circumferentially spaced ports 184 extend radially through cylinder 182, are positioned intermediate the axial ends of cylinder 182 and communicate between the interior thereof and the cavity of the reservoir 126'.

A valve assembly 186 is received within cylinder 182. Valve assembly 186 comprises: a valve spring 188; a keeper member 190; and a spherical valve 192. Keeper member 190 has a generally stepped cylindrical configuration and compirses an inner portion 194 and a reduced diameter outer portion 196. Portion 196 has an outer diameter thereof substantially equal to the inner diameter of spring 188 and is received therewithin adjacent one end thereof. Portion 194 has a coaxial seat 198 formed within the inner surface thereof to provide a seating surface for valve 192. A plurality of bores 200 extend horizontally through keeper member 190.

Valve assembly 186 is positioned within cylinder 182 such that spring 188 has one end thereof seated on closure member seating portion 180. The length of spring 188 is such that the outer end thereof which has received keeper member portion 196 therewithin urges valve 192 into engagement with seating sleeve 177 thereby closing off the reservoir and the passageway 123' in a well known manner.

The general operation of snubber 172 is quite similar to the operation of the snubber 132 as described hereinbefore, however, when utilizing the snubber 172 it would be expected that such snubber would operate more efficiently than snubber 132. For example the fluid discharging from the passageway 123 into the cavity of snubber 132 could do so at a relatively high velocity thereby disturbing the air-oil interface and entraining air within the hydraulic fluid. After a period of time an accumulated air entrainment in the system of the snubber 132 could result in an air locked snubber. With an arrangement such as snubber 172 hydraulic fluid would overcome the bias of spring 188, flow through bores 200 into cylinder 182 and be discharged therefrom through ports 184 and into the cavity. The ports 184 are large enough to cut down the velocity of the discharging hydraulic fluid thereby decreasing the occurrences of air entrainment within the hydraulic fluid of the system.

An additional operating feature of the snubber 172 is that because the ports 184 provide a somewhat restricted path for the flow from cylinder 182 a back pressure within cylinder 182 will result thereby decreasing chattering (i.e., movement of valve 192 against adjacent surfaces). Such reduction of chattering decreases maintenance of the snubber for there is less wearing contact between adjacent surfaces. At this point it is to be noted that the diameter or number of ports 184 are determined by the necessity to have enough discharge area to maintain the velocity of discharging hydraulic fluid within an acceptable maximum while simultaneously providing a back pressure which is great enough to decrease chattering but not too great as to hamper the snubbing feature of the snubber 172. Still further the cooperation of sleeve 177 and seat 198 aid in maintaining valve 192 in a steady substantially non-chattering relative position. It is to be noted that it is comtemplated that sleeve 177 and keeper member 190 be made of a wear resistent material to withstand the continued frictional wearing thereof.

A further variation of snubber 172 within the principles of this invention includes using a valve 130 such as shown in snubber 132 which has an orifice therewithin. Operation of such a snubber would be essentially as described hereinbefore with reference to snubber 132.

The advantage of the snubber embodiments shown in FIGS. 5 through 9 resides almost completely in the characteristics of being able to be used in place of a normal pair of bolster springs with the attendant advantages as hereinbefore set forth.

Preferred embodiments of this invention having hereinbefore been described it is to be realized that variations in the structure embodying the principles of this invention without departing from the scope of such principles.

What is claimed is:

1. In a dampened railway truck assembly selectively operable in loaded and unloaded conditions and having a hydraulic snubber apparatus interposed in a spring group intermediate a bolster member and a side frame member, the improvement comprising: means interposed between said snubber apparatus and one of said members to bias said snubber apparatus towards the other of said members; said means being operative to bias said snubber apparatus out of operative engagement with said one of said members when said truck assembly is normally operating in an unloaded condition; and said means and said snubber apparatus being cooperable to initiate hydraulic snubbing by said snubber apparatus substantially only when said railway truck assembly is normally operating in a loaded condition, the bias of said means is partially overcome and said snubber apparatus is in operative engagement with both of said members.

2. In a railway truck assembly as specified in claim 1 wherein when said truck assembly is normally operating in an unloaded condition said snubber apparatus engages only said other of said members.

3. In a railway truck assembly as specified in claim 2 wherein when said truck assembly is normally operating in said loaded condition said snubber assembly is simultaneously in engagement with both of said members.

4. In a railway truck assembly as specified in claim 1 wherein said means biases said snubber apparatus into engagement with said other of said members.

5. In a railway truck assembly as specified in claim 1 wherein said snubber apparatus includes means biasing a portion of said snubber apparatus towards said one of said members.

6. In a railway truck assembly as specified in claim 1 wherein said means and said snubber apparatus replace a normal spring of said spring group.

7. In a railway truck assembly as specified in claim 1 wherein said one of said members is said bolster member and said other of said members is said side frame member.

8. In a railway truck assembly as specified in claim 1 wherein said one of said members is said side frame member and said other of said members is said bolster member.

9. In a railway truck assembly as specified in claim 1 wherein said snubber apparatus is interposed inwardly adjacent an outer peripherial portion of said spring group.

10. A railway truck snubber assembly comprising: a hydraulic snubber apparatus adapted to be interposed in a spring group intermediate a bolster member and a side frame member of a railway truck assembly; means in communication with said snubber apparatus and adapted to be interposed between said snubber apparatus and one of such members to bias said snubber apparatus towards the other of such members; said means being operative to bias said snubber apparatus out of operative engagement with such one of such members when such truck assrmbly is normally operating in an unloaded condition; and said means and said snubber apparatus being cooperable to initiate hydraulic snubbing by said snubber apparatus substantially only when such railway truck assembly is normally operating in a loaded condition. the bias of said means is partially overcome and said snubber apparatus is in operative engagement with both of such members.

* * * * *

PATENTED SEP 24 1974

3,837,292

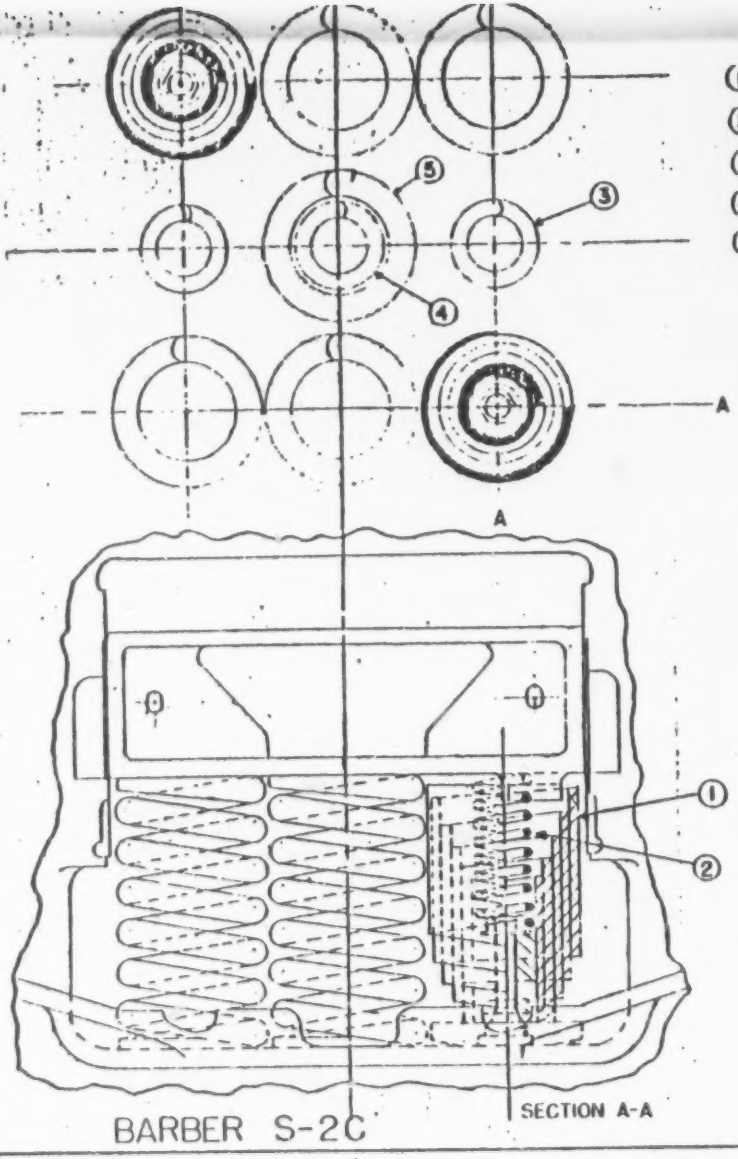
SHEET 3 OF 3

FIG. 6

FIG. 7

FIG. 5

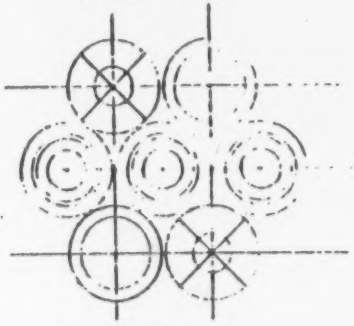
FIG. 8



	NO. REQ.	NAME	DRAWING NO.	FURNISHED BY
①	8	HOLLAND VOLUTE SNUBBER SPRING — E-2	B-206-C	HOLLAND CO.
②	8	ADAPTER SPRING 2.015" O.D. MAX. 6¼" F.H. 0.2253" BAR DIA.	B-332	"
③	8	BARBER SIDE SPRING		RAILROAD
④	4	INNER COIL SPRING A.A.R. D-5		"
⑤	20	OUTER COIL SPRING A.A.R D-5		"

R 409 HW

ASF A-3



5 OUTERS D-5
3 INNERS D-5
2 E-2 WITH SPRING

LIGHT CAR RIDING HEIGHT CONDITION

REF. — L.B.N.R.R. DRWG. NO. C-20790-H

PROPERTY OF
HOLLAND COMPANY
CHICAGO, ILL.

SPRING GROUP ARRANGEMENT
HOLLAND VOLUTE SNUBBER SPRING,
STYLE E-2, TO L.B.N.R.R. 80 TON
HOPPERS, NOS. 167,000-167,999

DATE	DRAWING No.	ISSUE
2/8/66	B-333	

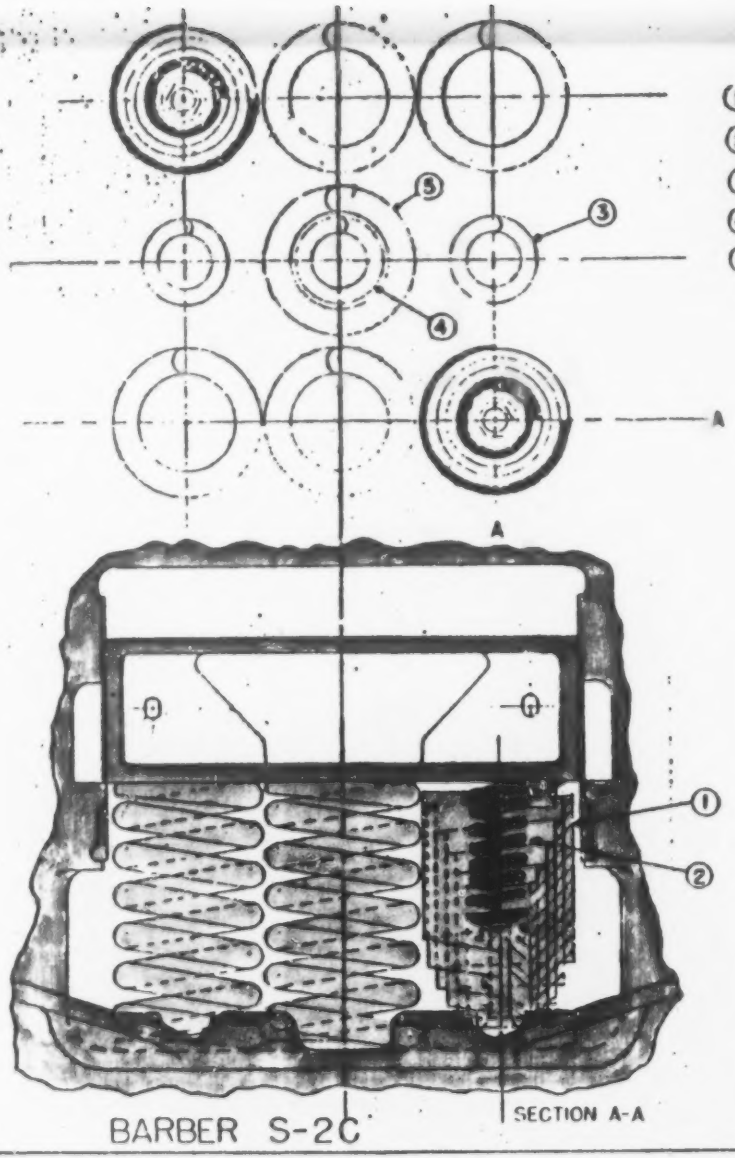
BY ASF | TR | CHK | APP'D EWM

PLAINTIFF'S EXHIBIT 409

BILL OF MATERIAL PER CAR SET

	NO. REQ.	NAME	DRAWING NO.	FURNISHED BY
①	8	HOLLAND VOLUTE SNUBBER SPRING — E-2	B-206-C	HOLLAND CO.
②	8	ADAPTER SPRING: 2.015" O.D. MAX. 6¼" F.H. 0.2253" BAR DIA.	B-332	"
③	8	BARBER SIDE SPRING		RAILROAD
④	4	INNER COIL SPRING A.A.R. D-5		"
⑤	20	OUTER COIL SPRING A.A.R D-5		"

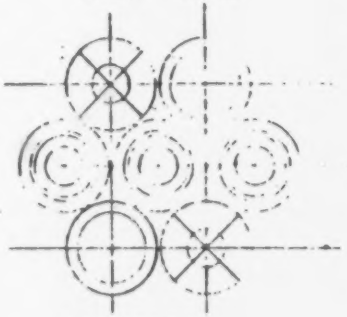
R 409 HW



BARBER S-2C

SECTION A-A

ASF A-3



5 OUTERS D-5
3 INNERS D-5
2 E-2 WITH SPRING

LIGHT CAR RIDING HEIGHT CONDITION

REF. — L.B.N.R.R. DRWG. NO. C-20790-H

PROPERTY OF
HOLLAND COMPANY
CHICAGO, ILL.

SPRING GROUP ARRANGEMENT
HOLLAND VOLUTE SNUBBER SPRING,
STYLE E-2, TO L&N R.R. 80 TON
HOPPERS, NO.S 167000-167,999

DATE	DRAWING No.	ISSUE
2/8/66	B-333	1

PLAINTIFF'S EXHIBIT 78

SPRING GROUP A

EACH SPRING GROUP TO CONSIST OF:
5 D-9 OUTER COIL SPRINGS
3 D-9 INNER COIL SPRINGS
2 HOLLAND R-2 SNUBBER SPRINGS
2 SPECIAL COIL SPRINGS

FOR APPLICATION OF SNUBBER RETAINING CLIPS SEE L & N DWG.

SPRING GROUP B

EACH SPRING GROUP TO CONSIST OF:
7 D-9 OUTER COIL SPRINGS
6 D-9 INNER COIL SPRINGS

SIDE CONTROL SPRINGS

SNUBBER

CORE DIA FOR RIVETS
CORE DIA FOR RIVETS

FRICTION PLATES ARE TO BE OILED TO SIDE FRAME CASTINGS AND IT IS RECOMMENDED THAT THE PROCEDURE OUTLINED ON DRAWING SHALL BE FOLLOWED

5'-0" SIDE BEARING CENTERS

IMPORTANT NOTE:
WHEN SNUBBERS ARE BROKEN OR MISSING FROM CAR REMOVE ALL SPRINGS FROM CAR AND REPLACE WITH CORRECT NUMBERS OF INNER AND OUTER COIL SPRINGS AS SHOWN IN SPRING GROUP B

SIDE FRAME
SIDE FRAME WEAR PLATE
ADAPTER
ROLLER BEARINGS
ROLLER BEARING ADAPTER
BRAKE BEAMS
BRAKE BEAM WEAR PLATES
TRUCK LEVER
TRUCK DEAD LEVER
DEAD LEVER GUIDE
BOTTOM CONNECTION
STUCK SIDE BEARING

SPRING TRAVEL

NOTE:
LIGHT CAR HEIGHT IS BASED ON RAIL LOAD OF 31,500 LBS.

NOTE
ROD LOWER LUG TO BE WELDED IN AS PER PAR. 84 STRIPED ON CARS.

NOTE
FOR CARS WITH GR. LOAD NOT EXCEEDING 220,000 LBS.

A-3

PLAINTIFF'S EXHIBIT 417

LOUISVILLE & NASHVILLE RR
LOUISVILLE, KY. MARCH 18, 1968
TRUCK NO 114-B
B-22228

UPDATE CHANGES

Dec. 4, 1934. W. F. KIESEL, JR. 1,983,088

RAILWAY CAR TRUCK

Filed Dec. 17, 1932

FIG. I.

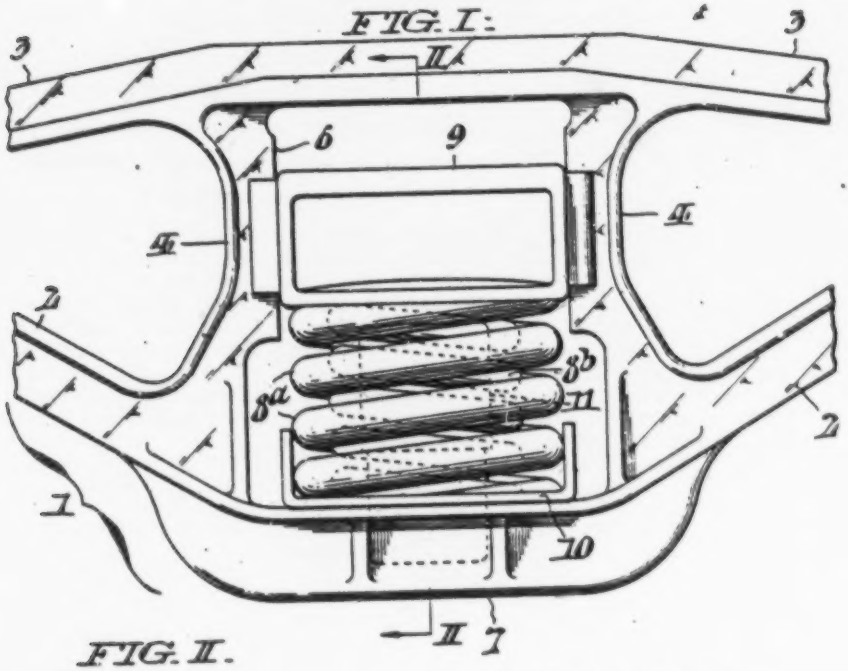


FIG. II.

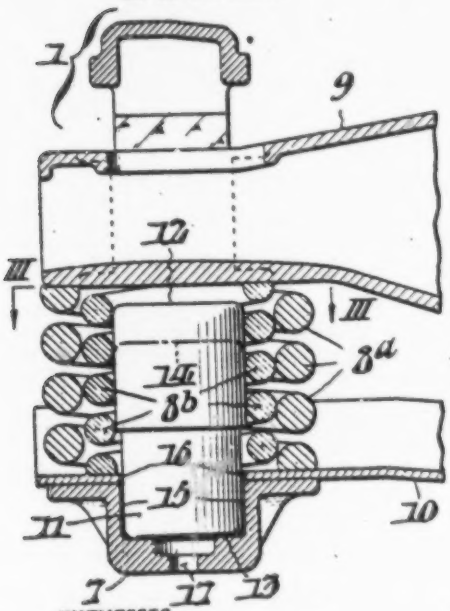
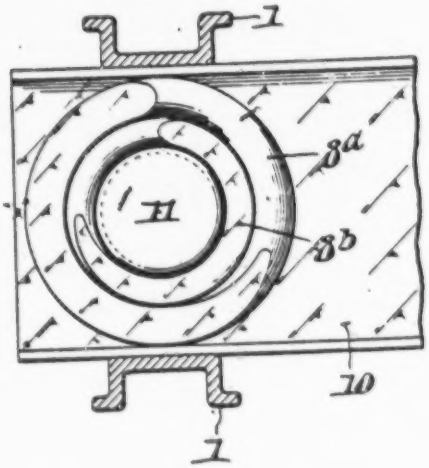


FIG. III.



WITNESSES:

Thomas W. Kerr Jr.

William Bell Jr.

INVENTOR:

William F. Kiesel, Jr.,

BY Fraser & Paul

ATTORNEYS.

PLAINTIFF'S EXHIBIT 27

Patented Dec. 4, 1934 1,983,088

UNITED STATES PATENT OFFICE

1,983,088

RAILWAY CAR TRUCK

William F. Kiesel, Jr., Hollidaysburg, Pa.

Application December 17, 1932, Serial No. 647,748

8 Claims. (Cl. 105—197)

This invention relates to railway car trucks, and more especially to the springs and associated parts by which the bolster of a car truck is supported within the truck side frames. Heretofore many schemes have been proposed for increasing the load carrying capacity of freight cars while maintaining easy riding qualities for the car body. Such schemes have for the most part involved radical changes in existing truck design.

The object of the present invention is to provide in a car truck a combination of shock absorbing means of differing characteristics which insures easy riding qualities for the car, under all conditions of loading, and wherein the arrangement is such as to require only a slight departure from present truck construction practice.

A further object of the invention is to provide in combination with the usual truck springs, or like resilient means for supporting the load carrying member, a shock absorbing device which is inactive under light loads, but which under heavy loads comes into play after a predetermined bolster deflection, and then serves adequately to support the load and to maintain proper riding qualities for the car.

A further object of the invention is to provide a truck side frame which in its general characteristics resembles side frames now in use, but which is designed to accommodate a shock absorbing device of greater solid height than the helical springs now customarily used.

Still other objects and advantages characterizing my invention will become more fully apparent from the description hereinafter set forth of one embodiment or example of the practice of the invention, the description having reference to the accompanying drawing. Of the drawing:

Fig. I represents a side elevation of a portion of a side frame of a railway car truck embodying my invention.

Fig. II represents a vertical cross section of the same, taken as indicated by the lines II—II of Fig. I; and,

Fig. III represents a horizontal cross section of the same, taken as indicated by the lines III—III of Fig. II.

With reference to the drawing, there is shown a truck having side frames 1 of a common construction, each side frame including tension members 2 and compression members 3. Guide columns 4 define a window 6 at the center of the side frame. The tension members 2 include a spring seat portion 7 upon which helical springs 8a, 8b are mounted. In the present example of my invention, an outer helical spring 8a and an inner helical spring 8b, arranged in concentric relation, are employed. A bolster 9 of customary form is supported at its ends upon the helical springs 8a, 8b, the bolster having capacity for vertical movement within the window 6 of the side frame, and being guided by the guide columns 4. A spring plank 10 joins one side frame 1 with the corresponding side frame at the opposite side of the truck. Each end of the spring plank 10 rests directly upon the spring seat portion 7 of the tension members 2 of the side frame.

For the purpose of adequately supporting the bolster 9 under heavy load conditions, there is provided in addition to the helical springs 8a, 8b a shock absorbing device 11, which may comprise upper and lower movable elements 12, 13 and which may take a great variety of forms. There are many well-known types of snubbers useful for this purpose, and the particular construction of the shock absorbing device 11 forms no part of this invention.

In its normal free position, the shock absorbing device 11 assumes the position shown in Fig. II. The solid height of the shock absorbing device is represented by the dot-and-dash line at 14. It will be apparent that the solid height of the shock absorbing device 11 is greater than the solid height of the helical springs 8a, 8b. In order to accommodate a shock absorbing device having the desired initial free position, the desired capacity, and the desired solid height, the side frame 1 is provided with a depression 15 in the seat portion 7 of the tension members 2. The depression 15 extends downward substantially below the top wall of the seat portion 7 and is constructed in such manner as to accommodate the base 13 of the shock absorbing device with a snug fit. Moreover, in the spring plank 10 there is an opening 16 conforming to the opening at the mouth of the depression 15, and hence the shock absorbing device 11 also serves as a locking pin maintaining the spring plank in proper relation with the seat member 7 of the side frame. Leading downward from the depression 15 through the bottom of the seat portion 7 of the tension members 2, there is an opening 17 useful for the purpose of removing the shock absorbing device 11.

According to the preferred arrangement, the helical coil springs 8a, 8b are arranged in concentric relation with each other as well as in

concentric relation with the shock absorbing device 11. However, various other arrangements of the coil springs can obviously be used and are within the contemplation of this invention.

In operation the shock absorbing device 11 functions in the following manner. Under empty car weight the helical coil springs 8a, 8b carry the entire load, and there is clearance between the bottom of the bolster 9 and the top of the shock absorbing device 11. When there is added to the static weight of the car body approximately one quarter of the car load capacity, the bolster engages the top of the shock absorbing device 11; and with heavier loads the shock absorbing device 11 cooperates with the helical coil springs 8a, 8b to give the desired easy riding qualities to the car. Even under excessive loads, the shock absorbing device 11 is of such capacity and of such solid height as to prevent the springs 8a, 8b from going solid, and accordingly even under excessively heavy loads there is still a yielding support for the bolster 9.

The preferred manner of assembling and disassembling the combination of springs and shock absorbing means described above is as follows. The trucks are assembled in inverted position. This is accomplished by inverting the bolster 9 and the side frame 1, then stripping the side frames over the ends of the bolster 9 and dropping the bolster into proper engagement with the guide columns 4 at the windows 6 of the side frames. The helical springs 8a, 8b with the shock absorbing devices 11 assembled centrally thereof, are then introduced above the inverted bolster, after which the spring plank 10 is placed on top of the springs and the shock absorbing device. During this operation wedges, bearings, and axles with wheels thereon, have also been put in place. The truck is then turned over into its normal running position.

When, due to the wear of wheels, bearings, or other parts, it becomes necessary to raise the bolster to bring the car coupler back to its normal position, shims may be introduced between the top of the springs 8a, 8b and the bottom of the bolster 9. As the truck of the present invention is thus assembled, the shock absorbing device 11 expands into the depression 15 at the seat portion 7 of the tension members 2, and forms a secure lock between the side frame 1 and spring plank 10. Moreover, the helical springs 8a, 8b are held by the shock absorbing device 11 against sidewise displacement and cannot be separated from each other.

When it is desired to remove the springs 8a, 8b, or the shock absorbing device 11 while the truck is beneath the car, this can be done in the usual manner by jacking up the bolster 9 until it comes in contact with the top chord formed by the compression member 3 of the side frame. The elements of the shock absorbing device 11, as well as the springs 8a, 8b, may then be removed by first applying a bar through the opening 17 beneath the depression 15 to raise the shock absorbing device above the level of the spring plank 10, and then shifting the spring assembly laterally across the window 6 of the side frame 1.

While I have described one particular example of the practice of my invention, it will be apparent that various changes may be made as to the form and arrangement of the springs, shock absorbing device, and associated parts without departing from the spirit of my invention as defined in the annexed claims.

Having thus described my invention, I claim:

1. In a railway car truck, the combination of a side frame, having a depression in the seat portion thereof, said depression extending downward through and below the upper web of the seat portion, a load carrying member, resilient means for supporting the load carrying member on the seat portion of said side frame, and a shock absorbing device disposed vertically for travel between said load carrying member and the base of said depression, said shock absorbing device being of a greater solid height than that of said resilient means.

2. In a railway car truck, the combination of a side frame, having a depression in the seat portion thereof, said depression extending downward through and below the upper web of the seat portion, a load carrying member, resilient means for supporting the load carrying member on the seat portion of said side frame, and a shock absorbing device adapted to be engaged by said load carrying member, said shock absorbing means being disposed adjacent to said resilient means with its base fitting snugly within the depression aforesaid.

3. In a railway car truck, the combination of a side frame, having a depression in the seat portion thereof, said depression extending downward through and below the upper web of the seat portion, a spring plank resting on said seat portion of the side frame and having an opening therein conforming to said depression, a bolster, resilient means on said spring plank above the seat portion of the side frame for supporting the bolster, and a shock absorbing device for said bolster comprising relatively movable elements disposed vertically adjacent to said resilient means with the lower element fitting snugly within the opening in said spring plank and within the depression in the seat portion of said side frame, and serving as a pin locking the spring plank to said seat portion.

4. In a railway car truck, the combination of a side frame, having a depression in the seat portion thereof, said depression extending downward through and below the upper web of the seat portion, a load carrying member, resilient means for supporting the load carrying member on the seat portion of said side frame, and a shock absorbing device comprising relatively movable elements disposed vertically between said load carrying member and the base of said depression with the lower element fitting snugly within said depression, said shock absorbing device being of a greater solid height than that of said resilient means.

5. In a railway car truck, the combination of a side frame having a tension member affording a spring seat and having a depression in the seat portion of said tension member extending downward through and below the upper web of the tension member, said tension member having an opening leading from said depression through its bottom wall, a bolster, springs for supporting said bolster on the seat portion of said tension member, and a shock absorbing device having its base seated in said depression above the opening aforesaid, said shock absorbing device being adapted to support the bolster when the same is heavily loaded.

6. In a railway car truck, the combination of a side frame having a tension member affording

a spring seat and having a depression in the seat portion thereof, a bolster, said depression extending downward through and below the upper web of the seat portion, a helical spring for supporting said bolster on the seat portion of said tension member, and a shock absorbing device disposed vertically between said bolster and the base of said depression in concentric relation within said spring.

7. In a railway car truck, the combination of a side frame having a tension member affording a spring seat and having a depression in the seat portion thereof, a bolster, said depression extending downward through and below the upper web of the seat portion, concentric helical springs for supporting said bolster on the seat portion of said tension member, and a shock absorbing device disposed vertically between said bolster and the base of said depression in concentric relation within said concentric springs.

8. A side frame for a railway car truck having a tension member affording a spring seat, having a centrally positioned depression in the seat portion thereof for accommodating the base of a shock absorbing device, said depression extending downward to the bottom wall of the tension member, and having an opening leading from said depression through the bottom wall of said tension member, through which opening access may be had to the base of said shock absorbing device.

WILLIAM F. KIESEL, Jr.

Dec. 4, 1934. W. F. KIESEL, JR 1,983,088

RAILWAY CAR TRUCK

Filed Dec. 17, 1932

FIG. I.

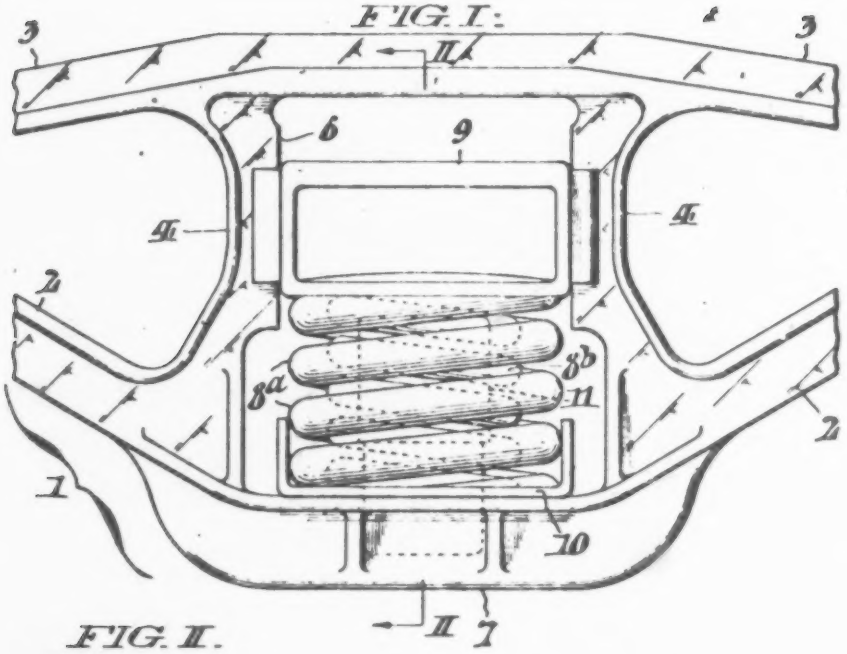


FIG. II.

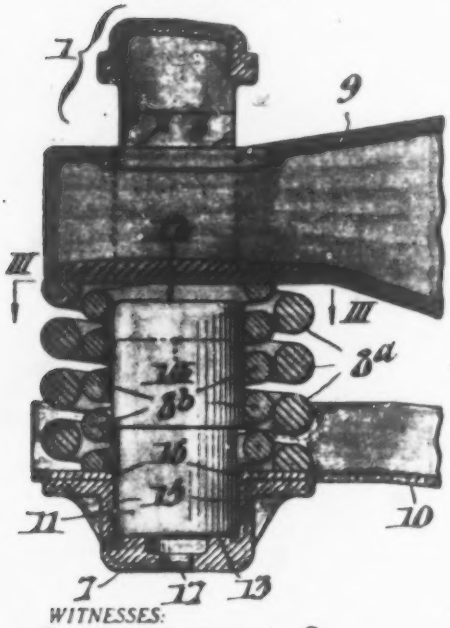
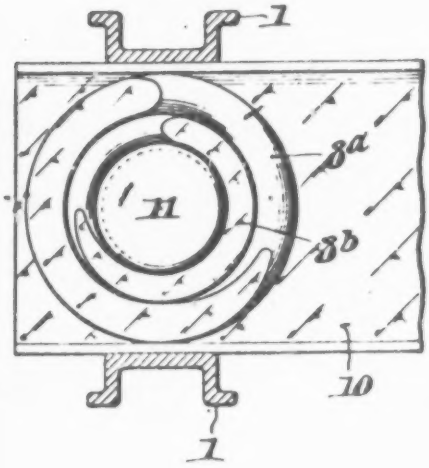


FIG. III.



WITNESSES:

Thomas W. Kerr Jr.

William Bell Jr.

INVENTOR.

William F. Kiesel, Jr.,

BY Fraley & Paul

ATTORNEYS.

PLAINTIFF'S EXHIBIT 79

4

Jan. 29, 1935. T. H. SYMINGTON 1,989,433

SNUBBED TRUCK SPRING

Filed July 1, 1930

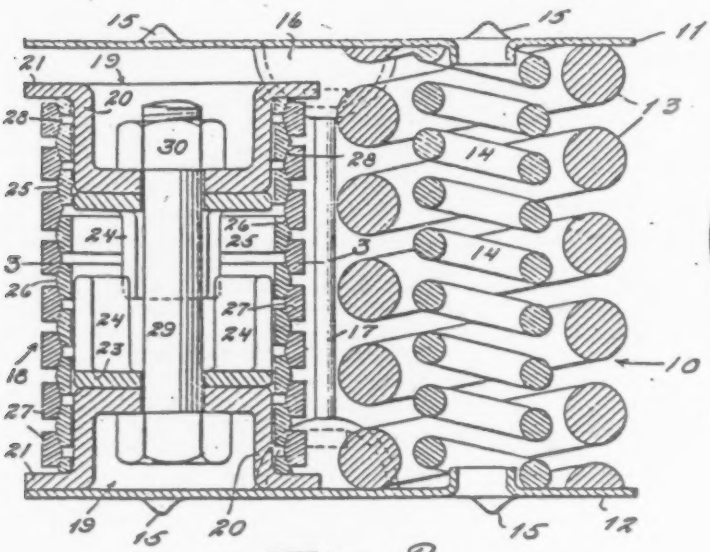


Fig. 2.

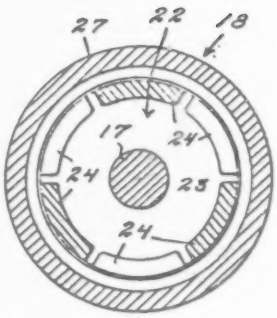


Fig. 3.

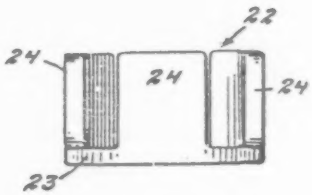


Fig. 4.

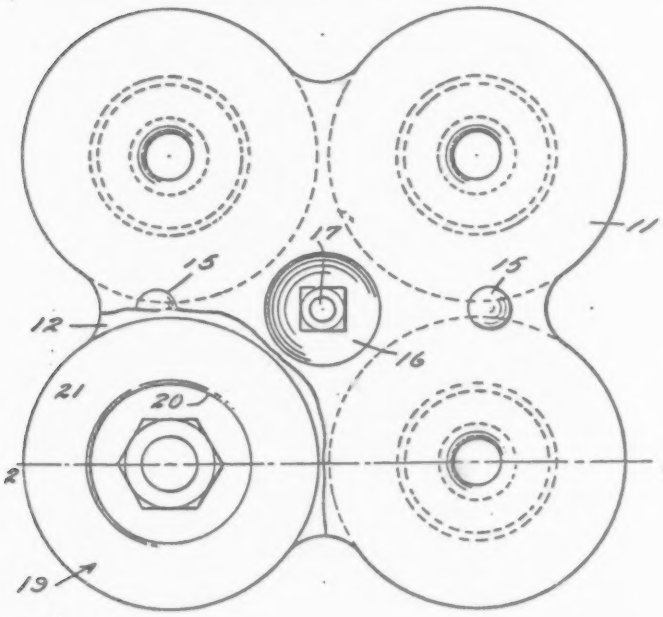


Fig. 1

Inventor

Thomas H. Symington

By John Milton Jester

PLAINTIFF'S EXHIBIT 60

Patented Jan. 29, 1935

1,989,433

UNITED STATES PATENT OFFICE

1,989,433

SNUBBED TRUCK SPRING

Thomas H. Symington, Baltimore, Md., assignor to T. H. Symington & Son, Inc., Baltimore, Md., a corporation of Maryland

Application July 1, 1930, Serial No. 465,182

14 Claims. (Cl. 267—4)

The invention relates to railway truck spring suspension.

It is well known that the ordinary means for supporting the truck bolster in a railway car truck comprises a group or nest of helical springs, the number and capacity of which necessarily varies in accordance with the character of the car. The springs in any group or nest are customarily of the same height, travel and capacity. A great difficulty has been that a spring assembly capable of properly sustaining the maximum load is too stiff to provide proper resilience under no load or light load conditions. Conversely, a spring suspension which will act satisfactorily under light load conditions will go solid and fail to function under maximum load conditions. The problem has consequently arisen as to the obtaining of a proper balance. Furthermore, as the ordinary springs have the same characteristics they also have the same period of vibration, the result being that oscillations starting for instance by passage of the wheels over rail joints or low spots in the track build up when the spring deflections become synchronized with the passage of the wheels over rail joints, etc., and this cumulative action may even cause derailment of the truck.

It is with all of the above facts in view that I have devised the present invention which has for its general object the provision of a spring assembly including spring units of ordinary type combined with a friction producing means adapted to come into play upon partial deflection of the standard springs for absorbing shocks and providing the proper cushioning effect under heavy load conditions, the usual springs performing their function satisfactorily under light load conditions.

An important object of the invention is to provide a shock absorbing suspension mechanism in which one or more of the ordinary springs may be simply replaced by friction producing units.

Another object of the invention is to provide a mechanism of this character in which the friction producing means is of less height and travel than the ordinary helical springs so that the spring and friction means will operate sequentially and then simultaneously.

Another object of the invention is to provide an assembly in which the free or live standard springs are assisted under heavy load conditions by a combined spring and friction producing means having high absorption capacity, the standard helical springs being thereby relieved of strain which might otherwise cause them to go solid.

Another object of the invention is to provide an absorption unit embodying a combination of friction producing elements and spring elements arranged and mounted in cooperating relation, this unit being capable of employment to replace a helical spring in a standard spring nest so that the ultimate capacity of the entire assembly may be quickly increased.

Another important object of the invention is to provide a cushioning means embodying an absorption unit in which the combined spring and friction producing means may be lubricated and maintained in such condition without the provision of any auxiliary housing or the like, the purpose being to prevent any unnecessary wear on the parts so that their life will be prolonged.

Another object of the invention is to provide an absorption unit having an ultimate capacity many times that of what will be required of it even in the most strenuous service so that the elements will not be subjected to any undue fiber stresses and will therefore be free from excessive strains and not liable to breakage, stretching or other distortion.

To the attainment of the foregoing and other objects and advantages, the invention preferably consists in the details of construction and the arrangement and combination of parts to be hereinafter more fully described and claimed, and illustrated in the accompanying drawing in which:

Figure 1 is a plan view of a spring nest with a portion of the top cap broken away to show a plan view of the novel friction producing or absorption unit,

Figure 2 is a vertical cross sectional view taken on the line 2—2 of Figure 1.

Fig. 3 is a detail cross section taken on the line 3—3 of Figure 2,

Figure 4 is a detail elevation of one guide member.

Referring more particularly to the drawing it will be observed that I have disclosed a spring nest, group or assembly indicated as a whole by the numeral 10 and comprising upper and lower spring plates or caps 11 and 12 between which is a plurality of spring units which may be of the single or double coil type, as preferred, but which are here represented as including outer coils 13 and inner coils 14. This assembly or nest is of course intended to be mounted in the window opening of a side frame in the usual manner and the spring plates or caps are therefore shown as having the usual tits or projections 15 thereon adapted to enter holes or recesses in the bottom of the window opening and the underside of the bolster so that the nest will be retained in place.

As is customary, the spring plates or caps have depressed central portions 16 extending toward each other and connected by a tie bolt 17 for holding the parts assembled prior to installation in a truck. In the present instance the nest is shown as of the four unit type but it will be distinctly understood that this is simply for purposes of illustration as it is well known that higher capacity cars are equipped with spring nests embodying a larger number of units.

In carrying out my invention I provide an absorption mechanism formed as a complete and separate unit or entity and indicated as a whole by the numeral 18, this unit being intended to replace one of the spring units. It is of course apparent that more than one absorption unit may be used if preferred though ordinarily one is probably sufficient.

The friction producing unit 18 is here disclosed as comprising similar or counterpart upper and lower caps 19 which may be formed as drop forgings, stampings or the like but which are preferably the former. Each of these caps includes a cylindrical portion 20 terminating at one end in an outstanding flange 21, and the two flanges are arranged adjacent the upper and lower spring caps as clearly indicated, the lower cap being preferably spot welded or otherwise secured to the lower cap 12. It is intended that these caps engage and confine between them the combined spring and friction producing means and as this means comprises a plurality of coacting elements, the cylindrical portions 20 of the caps constitute guides. However, as there is considerable space between the adjacent ends of the caps it becomes necessary to provide other guide means and this may be readily accomplished by arranging between the caps a pair of guide members 22 which may likewise be formed as pressings or stampings but which are preferably drop forgings spot or otherwise welded to the caps. It is even conceivable that these guides 22 might be formed integrally of the caps, this being considered a very minor detail. Each of the guides is represented as including a circular or disk-like horizontal portion 23 from which extend lugs or fingers 24, these fingers on the two guide members interfitting as clearly indicated in Figure 2 and being of such length as not to interfere with relative movement of the caps 19 toward each other, or more precisely, downward deflection of the unit, to the maximum extent desirable. While spot welding is referred to as the means or method of connecting the guide members 22 with the caps 19 it is conceivable that some other securing means might be resorted to if ascertained to be advantageous.

The resilient friction producing means is shown as comprising an inner series of spring rings 25 spaced apart and surrounding the cylindrical portions 20 of the caps and also surrounding the assembled interfitting fingers 24. These inner rings are of double frusto-conical shape, that is to say their outer peripheries are tapered off or reduced gradually in diameter from the center toward both ends so as to provide inclined friction faces 26. Located outwardly of and coacting with the rings 25 and located opposite the spaces therebetween and in overlapping relation thereto are outer spring rings 27 which have their inner peripheries flared outwardly from the center toward both ends or edges and corresponding to the taper or inclination of the inclined faces 26, these inclined faces on the outer series of rings being indicated at 28.

The intention is that the friction unit 18 be put in the first place under a certain initial compression so that under light load conditions the weight of the car and its lading will be borne by the standard spring units. This means that the friction unit is not to become operative until the load on the nest exceeds a certain predetermined limit. As a consequence it is intended that the top of the friction unit be spaced somewhat below the upper cap of the nest in order that it will not be engaged thereby to energize the friction unit until the predetermined load has been exceeded. To bring this about is really a very simple matter and to accomplish it I preferably provide a tie bolt 29 which passes through the caps 19 and through the centers of the disk portions 23 in the guide members 22.

In actual practice under the A. R. A. standard the free height of the helical springs in a nest such as that disclosed is 8¼ inches. As mentioned above it is intended that the nut 30 on the tie bolt 29 be screwed down to reduce the free height of the friction unit 18 so that the helical springs may be compressed for a portion of their travel before the friction unit becomes effective. However, the exact degree of the initial compression of the friction unit is a matter which depends upon different circumstances, that is to say number of helical springs in the unit, the capacity of the nest, the character of the car and the lading to be carried thereby, etc. No dimensions or no relative proportions of the normal height of the friction unit with respect to the free height of the helical springs are given as it is easily conceivable that there may be considerable variations brought about to suit different requirements by the very simple expedient of adjusting the nut 30 which is, however, not intended to be shifted after the unit is set for a certain definite installation. Springs or spring rings of the type shown at 25 and 27 and arranged in a manner such as that disclosed are capable of withstanding a tremendous pressure, the total capacity of a unit built up from the number of elements shown being in the neighborhood of 82,000 pounds which is far more than the unit will ever be called upon to withstand, it being probable that the load will not exceed one-half of this amount. In general practice it is very likely that an initial compression of 4,000 or 5,000 pounds, brought about by the tie bolt 29, will be entirely sufficient to reduce the free height of the friction unit to a point where the helical springs may have the desired travel before the friction unit becomes effective so that the latter may operate as a reserve cushioning means for snubbing any further compression of the helical springs.

In the operation, it will be seen that under light or moderate load conditions the weight is borne by the helical springs. However, when there is any tendency for the helical springs to go solid, either as the result of overloading or insufficient capacity thereof, or as the result of vertical jiggle of the truck bolster, such as results from synchronization of vibration of the helical springs with passage of the car wheels over rail joints, low spots, etc., the upper spring cap will engage upon the upper cap 19 of the absorption unit and will exert a strong downward thrust upon the inner and outer series of rings 25 and 27. Owing to the fact that the inner rings have frusto-conical outer peripheries and the outer rings have the correspondingly tapered or inclined inner peripheries, there is a wedging action, there being a compressive force exerted radially inwardly upon

the inner rings and an expansive force exerted radially outwardly upon the outer rings. Though these rings are continuous they are of spring material and may consequently yield to a limited extent when subjected to very high pressures. Actually there is no great movement of the respective series of rings either inwardly or outwardly though the former can be compressed and the latter stretched slightly. The resistance of these springs to the compressive or expansive force provides resilience of high capacity and at the same time the tendency of the springs to be moved axially results in the development of a high degree of friction between the contacting cooperating tapered or inclined surfaces 26 and 28. This combination of resilience and friction will render this entire unit most advantageous for taking care of overloading of the standard springs in the nest and particularly for snubbing any jiggling movement which may develop. This latter mentioned function is particuarly true as it is obvious that the natural period of vibration of the friction unit 18 is entirely different from that of the standard or helical coil.

If it is so desired, in order to reduce wear or unnecessary wear on the coacting parts, it is a simple matter to pack the interior of the unit 18 with some suitable lubricant inasmuch as the contacting rings 25 and 27 being in close engagement constitute, in effect, a housing which will act to retain the lubricant and prevent it from becoming lost.

From the foregoing description and a study of the drawing it will be apparent that I have thus provided an extremely simple, easily assembled and installed and highly efficient cushioning mechanism for railway car truck bolsters or the like and one in which adequate means has been provided for tremendously increasing the total capacity without requiring entirely new equipment, as the desirable results are achieved by the mere replacement of one of the ordinary spring units with a combined spring and friction unit capable of fulfilling all the functions required of it. It is believed that the construction, operation, and advantages should be readily apparent to one skilled in the art without further explanation.

While I have shown and described the preferred embodiment of the invention, it should be understood that the disclosure is merely an exemplification of the principles involved as the right is reserved to make all such changes in the details of construction as will widen the field of utility and increase the adaptability of the device provided such changes constitute no departure from the spirit of the invention or the scope of the claims hereunto appended.

Having thus described the invention, I claim:

1. A railway car truck spring assembly comprising the combination of a plurality of coil springs of A. R. A. standard character and free height, and a special unit of less normal height, the special unit being energized sequentially with respect to the standard springs and then simultaneously therewith under increasing load conditions, said special unit comprising series of respectively laterally compressible and expansible elements and means for energizing the same.

2. A railway car truck spring assembly comprising the combination of a plurality of coil springs of standard free height, and a special unit of less normal height, the special unit being energized sequentially with respect to the standard springs and then simultaneously therewith under increasing load conditions, said special unit comprising a series of laterally compressible spring members and a series of laterally expansible spring members having a wedging relation.

3. A railway car truck spring assembly comprising the combination of a plurality of coil springs of standard free height, and a special unit of less normal height, the special unit being energized sequentially with respect to the standard springs and then simultaneously therewith under increasing load conditions, said special unit comprising a series of laterally compressible spring members and a series of laterally expansible spring members having a tapered interfitting relation.

4. A railway car truck spring assembly comprising the combination of a plurality of standard helical spring units operating to support loads up to a predetermined limit, and a special unit arranged to operate simultaneously with said helical springs beyond said predetermined limit, said special unit embodying coacting series of frictionally engaged concentric spring members maintained under initial compression.

5. A spring assembly comprising a plurality of helical springs and a special unit embodying inner and outer spring rings having wedging engagement, and means for maintaining said special unit under initial compression.

6. A spring assembly comprising a plurality of helical springs and a special unit embodying inner and outer spring rings having wedging engagement, means for maintaining said special unit under initial compression, comprising caps at the ends of the series of spring rings, and means connecting the caps.

7. A spring assembly comprising a plurality of helical springs and a special unit embodying inner and outer spring rings having wedging engagement, means for maintaining said special unit under initial compression, comprising caps at the ends of the series of spring rings, and means connecting the caps, said spring rings contacting closely and cooperating to define a substantial housing for containing lubricant.

8. A railway car truck spring assembly comprising upper and lower caps with a plurality of interposed standard height helical springs, and a special unit interposed between the caps, said special unit comprising a pair of end caps, an inner series of spring rings located between the end caps, an outer series of spring rings, and tie means connecting the end caps for holding said special unit under initial compression, said inner and outer rings having wedging engagement.

9. A railway car truck spring assembly comprising upper and lower caps with a plurality of interposed standard height helical springs, and a special unit interposed between the caps, said special unit comprising a pair of end caps, an inner series of spring rings located between the end caps, an outer series of spring rings, and tie means connecting the end caps for holding said special unit under initial compression, said inner and outer rings having their outer and inner peripheries respectively oppositely tapered from their centers to define coacting frusto-conical portions for exerting a wedging action and developing friction during closure of the unit.

10. A spring assembly comprising a plurality of helical springs and a special unit embodying a series of inner and a series of outer continuous spring rings having wedging engagement and spaced apart axially, caps at the ends of said unit, tie means connecting the caps, and guide means located between the caps and within the inner spring rings.

11. A spring assembly comprising a plurality of helical springs and a special unit embodying a series of inner and a series of outer continuous spring rings out of contact axially having wedging engagement radially, caps at the ends of said unit, tie means connecting the caps, and guide means located between the caps and within the inner spring rings in spaced relation thereto, said guide means having interfitting relation.

12. An absorption unit comprising outer and inner continuous spring rings spaced apart longitudinally and contacting laterally, caps upon the ends thereof, tie means connecting the caps, and guide members located between the caps and within the inner spring member in spaced relation to the latter.

13. An absorption unit comprising outer and inner series of continuous spring rings spaced apart longitudinally and contacting laterally, caps upon the ends thereof, tie means connecting the caps, and guide members located between the caps and within the inner spring member, said guide members having interfitting relation with each other and being spaced from the inner periphery of the inner rings, said caps being spaced from the endmost outer rings and contacting with the endmost inner rings.

14. An absorption unit comprising outer and inner spring members, caps upon the ends thereof, a tie bolt connecting the caps, and guide members located between the caps and within the inner spring member, said guide members being formed as disks covering the innermost portions of the caps apertured for close engagement upon the tie bolt and formed with alternately arranged interfitting fingers.

THOMAS H. SYMINGTON.

267. SPRING DEVICES

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Search Room

E-26

Jan. 29, 1935. T. H. SYMINGTON 1,989,433

SNUBBED TRUCK SPRING

Filed July 1, 1930

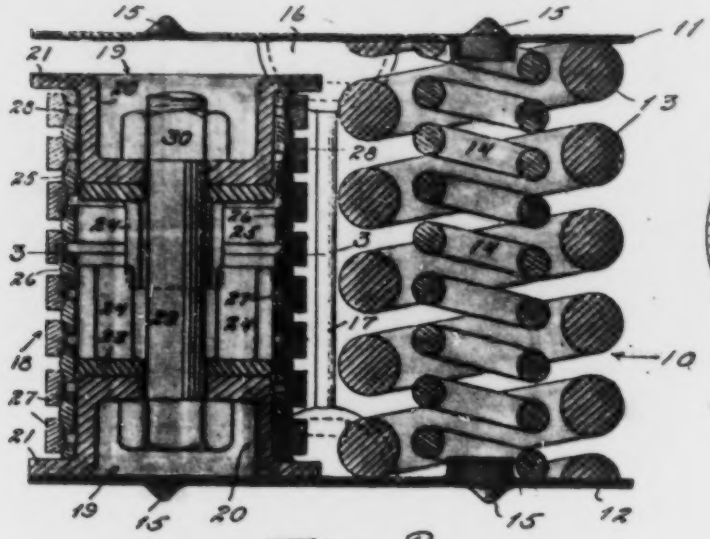


Fig. 2.

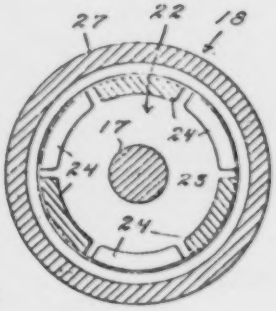


Fig. 3.

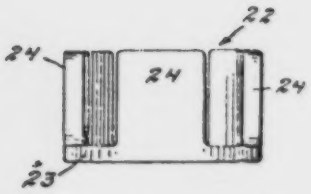


Fig. 4.

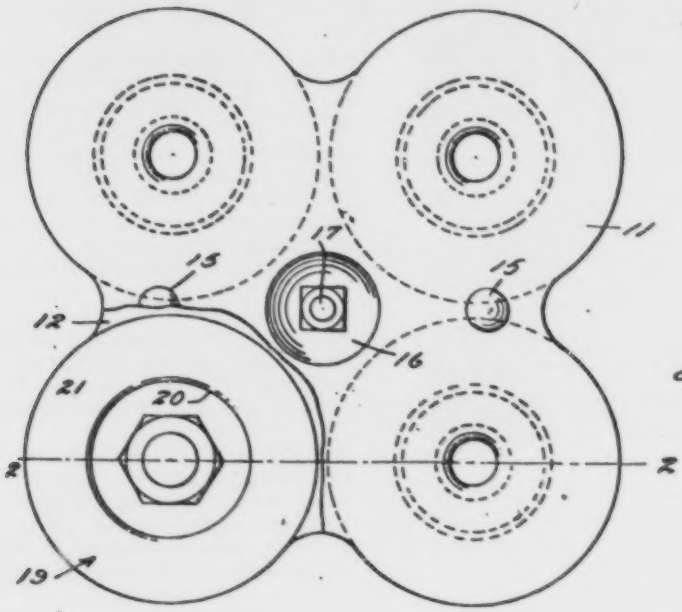


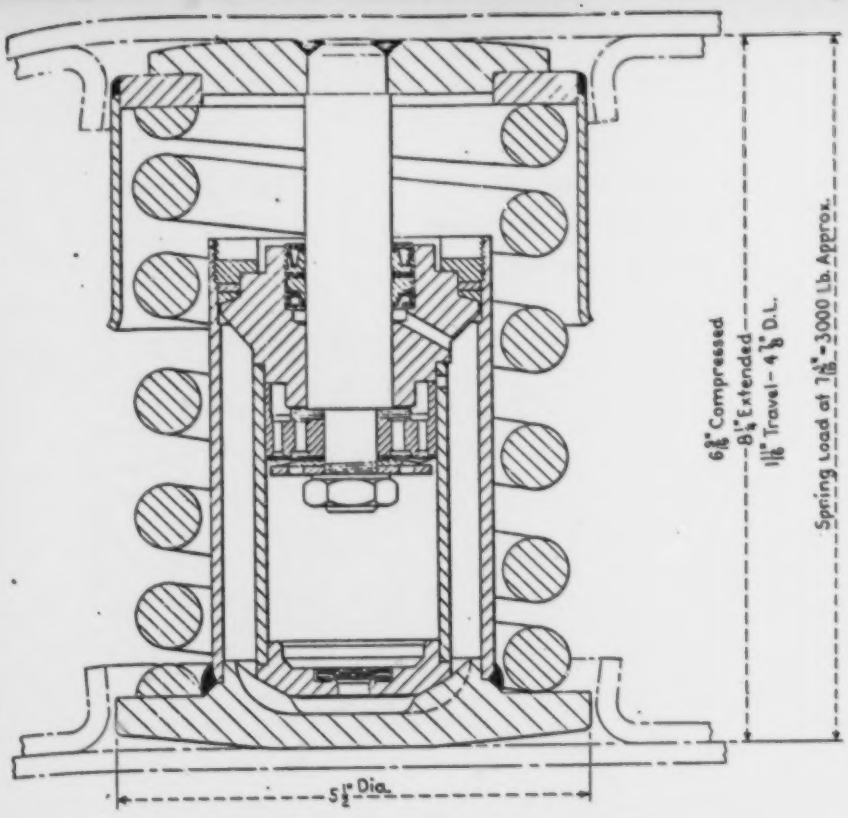
Fig. 1

Inventor

Thomas H. Symington

By John Milton Jester

PLAINTIFF'S EXHIBIT 80



A Cross Section of the Shock-Absorber Unit

Shock Absorber for Freight Cars

Based on experience gained in equipping a large percentage of all railroad passenger cars built since 1936 with hydraulic shock absorbers and a notable record as manufacturers of shock absorbers for U. S. tanks, jeeps, scout cars and heavy trucks, the Monroe Auto Equipment Company, Monroe, Mich., has recently announced the development of a new hydraulic shock absorber for freight cars. Specific objectives sought in the development of this device are uniformly dependable performance in cushioning shocks to lading and car structures; quiet, efficient action; long life, and general freedom from the necessity of servicing.

The new hydraulic shock absorber is a small, compact and self-contained unit which replaces one conventional truck spring in the spring cluster supporting each end of the truck bolster. It offers hydraulic resistance to the compression movements and contains an external spring which carries part of the load imposed by the weight of the car and also returns the shock absorber to its original position. Hydraulic resistance inside the pressure chamber is controlled by a series of spring-steel discs used in conjunction with a predetermined metered orifice. The control can be varied to meet any required conditions by using the proper combination of orifice and pressure relief. The pressure chamber is surrounded by a large oil-reservoir chamber to compensate for the displacement of the piston rod.

The Monroe Hydraulic Shock Absorber Replaces One Oil Spring in Each Bolster Spring Cluster

In operation, oil passes from the reserve to the pressure chamber through a non-return valve in the lower part of the pressure chamber. The unit is a sealed assembly at the lower end so there can be no leakage at this point, and the upper end is sealed with synthetic rubber seals. The oil used is said to assu uniform action under all temperatu and weather conditions encountered normal railway operation.

Another development of this compa is a stabilizer designed to minimize t swaying of freight cars caused by tra irregularities or curves. This devi consists primarily of a torsion bar e tending across each truck and connect between the bolster and truck frame such a way that any tendency of the c body to rock on the truck centers is r sisted by torsion in the car. This ty of device has demonstrated its value passenger service.

This company has also effected a nu ber of improvements in passenger-c hydraulic shock absorbers. The mo fied shock absorbers are said to be light and more economical, both in origin cost and in use. Higher pressures a possible because of closer tolerances ar improve[illegible] the pressure char ber, sha[illegible] val seats.

PLAINTIFF'S EXHIBIT 68

NEW

The Modern Gas Turbine. By R. To Sawyer. Published by Prentiss-Hall, In 70 Fifth avenue, New York. 250 page 6 in. by 9 in., 131 illustrations. Pri $4.00.

The gas turbine has been very much in t limelight during the past three or fo years and yet because of the war much the development work during that perio has either been done without any gre amount of publicity or has mainly been th subject of papers before technical societie The gas turbine, in its several forms, ap pears to have great possibilities in the fu ture and there is considerable curiosity con cerning its principles and applications bot on the part of the layman and the enginee in industry.

With the idea of satisfying the needs o both these groups the author of this non technical work has co-ordinated the avail able data on the subject into a book that i well organized and extremely readable From the opening chapters dealing with historical background, through chapter which present the fundamentals of princi ples and design and on into that part deal ing with the many practical applications o the gas turbine, the author has kept in mind the diversity of interests of the reade to such an extent that irrespective o whether he be in railroad, marine, public utility or aeronautical work his questions will find an answer.

Of particular interest to the railroad man is the chapter on the gas-turbine locomotive. In it are discussed the existing applications, both in this country and Europe, of the gas turbine as a supercharger for Diesel engines and as a prime mover. Design and performance data are included that enable the reader to make comparisons with existing types of railroad motive power and to lay a groundwork of knowledge of the subject that will be valuable in appraising future developments.

Nov. 16, 1937. D. F. SPROUL 2,099,240

BOLSTER SUPPORTING UNIT

Filed Dec. 31, 1934

Fig. 1

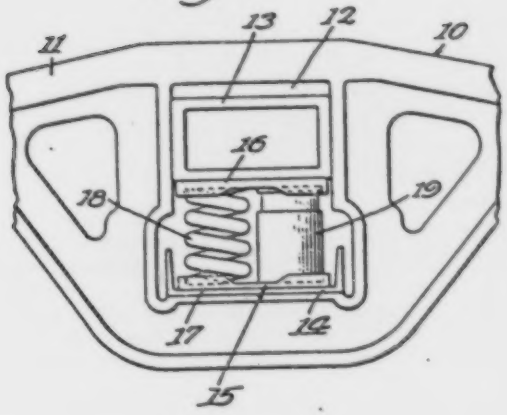


Fig. 3

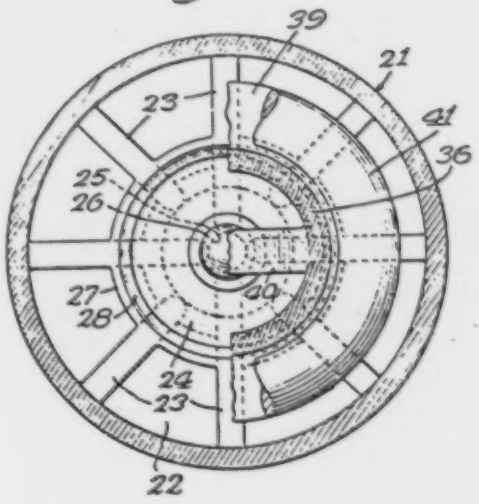


Fig. 2

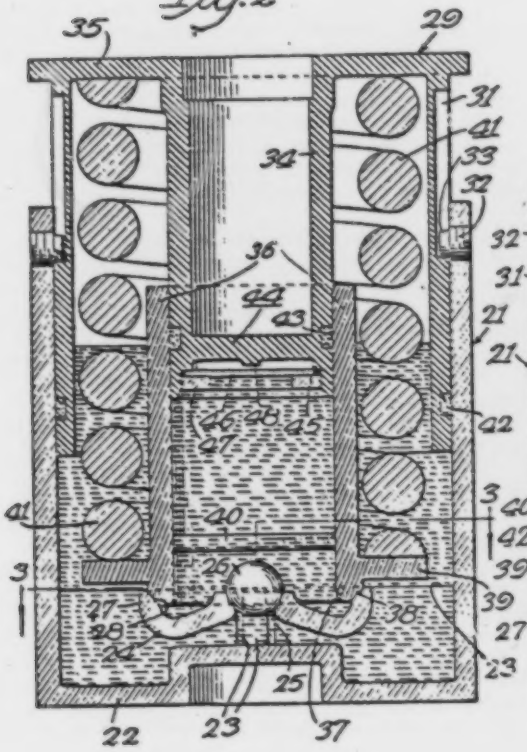
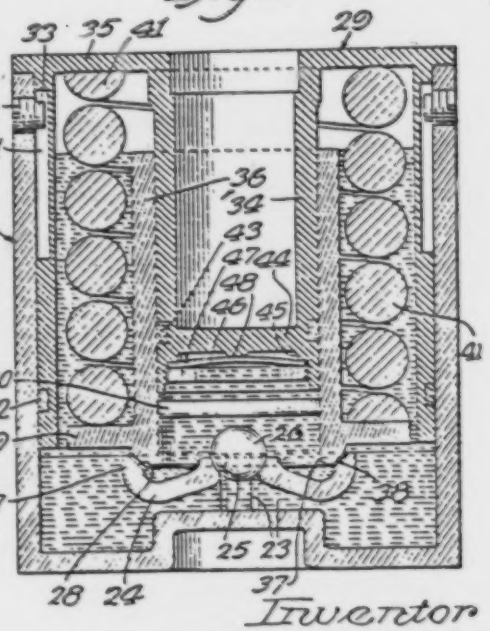


Fig. 4



Inventor

Donald F. Sproul

By Gillson, Mann & Gillson Attys

PLAINTIFF'S EXHIBIT 61

Patented Nov. 16, 1937 2,099,240 E-29

UNITED STATES PATENT OFFICE

2,099,240

BOLSTER SUPPORTING UNIT

Donald F. Sproul, Chicago, Ill., assignor to Cardwell-Westinghouse Company, a corporation of Delaware

Application December 31, 1934, Serial No. 759,817

9 Claims. (Cl. 267—4)

This invention relates to spring units, and, more particularly, to a bolster supporting spring member.

One of the objects of the invention is the provision of a new and improved spring unit having novel means for resisting the compression of the unit.

Another object of the invention is the provision of a new and improved spring unit having novel means for preventing harmonic vibration of the unit in use.

A further object of the invention is the provision of a new and improved spring unit of the dimensions of a conventional helical railway bolster spring but with greatly increased capacity.

Another object of the invention is the provision of a spring unit adapted for supporting a railway bolster that is simple in construction, efficient in operation, that is adapted to be substituted for a conventional helical bolster spring and which is not likely to become broken or get out-of-repair.

Other and further objects and advantages of the invention will appear from the following description taken in connection with the accompanying drawing, in which:

Fig. 1 is a side elevation of a railway truck with parts broken away and parts omitted for the sake of clearness;

Fig. 2 is a vertical section of the bolster supporting unit;

Fig. 3 is a section on the broken line 3—3 of Fig. 2; and

Fig. 4 is a section similar to Fig. 3 but showing the unit compressed.

In spring suspension for railway freight cars, it is common practice to employ a spring assembly of helical springs for supporting each end of the bolster from the truck frame. The helical type of spring is eminently satisfactory so far as its function of resiliently supporting the weight of the car is concerned, but it has the disadvantage that it is subject to harmonic vibration. In other words, under certain conditions, as when the ends of the rails become slightly elevated or depressed or where the wheels have flat portions on their peripheries or treads, and the speed is such as to cause the movement of the wheels over these rail joints or the rotation of the flat portions on the peripheries of the wheels to synchronize with the periodic vibration of the spring assembly, the vibrations will build up to such an extent that the car if heavily loaded may damage the springs by causing them to go solid and in doing so to break or otherwise injure the frame. Instances are known where this harmonic vibration has built up to such an extent as to cause the car to become derailed. Furthermore, the building of freight cars with progressively increasing sizes and weights has necessitated the use of springs of greater and greater capacities. But the small space allotted to the springs by car builders creates a serious problem for the spring designer to provide the desired spring capacity in the required space.

The present invention is designed to overcome these difficulties by providing a spring unit that may be substituted for one or more of the helicals in a conventional bolster supporting spring assembly, that has the desired capacity and is provided with novel means for preventing harmonic action of the assembly.

Referring now to the drawing, the reference character 10 designates a portion of a railway truck 12 comprising a side frame 11 having a bolster opening therein through which the end of the bolster 13 extends. A spring plank 14 extends through the opening and a spring assembly designated generally by the reference character 15 is inserted beneath the bolster and rests on the spring plank for resiliently supporting the bolster. Since the specific construction of the side frame and bolster constitute no part of the present invention, it is not thought necessary to further illustrate or describe the same. The spring assembly 15 comprises upper and lower spring plates 16 and 17 between which are helical springs 18, one of which is shown in Fig. 1, and one or more spring units 19. The spring unit 19 is so designed as to increase the capacity of the spring assembly and prevent harmonic vibration thereof.

In the form of the device shown, a cylinder 21 is provided having a bottom wall or base 22 which is preferably circular and provided with upwardly extending fins or ribs 23 that may be, and preferably are, integral with both the base and side of the cylinder. The inner ends of the ribs 23 are integral with a circular plate 24 which has an axial opening 25 therethrough. The upper portion of the plate about the opening is beveled to constitute a valve seat for a ball valve 26. The plate 24 is concave and is provided with an upwardly extending peripheral portion 27 which is beveled on its inner edge, as at 28, to form a valve seat, as will presently appear.

A hollow piston 29 is fitted within the cylinder 21. This piston constitutes the supporting portion of the unit and telescopes within the cylinder 21. Suitable means are provided for limiting the outward movement of the piston relative to

the cylinder. In the form of construction shown, the piston is provided with a plurality of peripheral grooves 31 extending longitudinally of the cylinder wall and a set screw 32 secured in the upper end of the cylinder 21 and provided with a projection 33 engaging in the groove 31 is adapted to prevent withdrawal of the piston from the cylinder. The piston 29 is provided with an auxiliary piston 34 which extends downwardly axially of the base or supporting end wall 35 of the piston 29. This piston is adapted to telescope into an auxiliary cylinder or valve member 36, the lower end of which is provided with an extension 37 having a beveled surface 38 for seating on the bevelled surface 28 of the plate 24. The extension 37 overhangs or projects inwardly beyond the inner edge of the upwardly extending portion 27. The auxiliary cylinder 36 is provided adjacent its lower end with a flange 39 which constitutes a seat for a spring 41 which encircles the sleeve 36 and engages the top plate 35. This spring is adapted to return the parts to extended position after compression. The piston 29 and the auxiliary piston 34 are provided with suitable piston rings or packing 42 and 43, respectively.

When the parts are assembled, the cylinder 21 is partially filled with a liquid, preferably above the level of the diaphragm 46 when the unit is in extended position, and in the operation of the device when the unit is compressed, the liquid in the auxiliary cylinder or valve member 36 will be forced downwardly by the auxiliary piston 34 and this hydraulic pressure operating on the overhanging extension 37 will elevate the member 36 against the tension of the spring 41, permitting the escape of the liquid from the auxiliary cylinder or valve member 36 into the main cylinder 21.

The capacity of the units may be varied by varying the dimensions of the overhanging extensions 37. If the parts are so constructed that the part 37 overhangs the valve seat to a greater extent than as shown on the drawing, the capacity of the unit will be less than the unit shown and vice versa.

When it is desired to increase the capacity of the spring assembly, it may be done in one of two ways, either by substituting additional units for the helicals or by employing units in which the overhanging extension 37 is reduced.

Suitable means are provided for cushioning the initial compressive forces which may be received on the plate 35 while in service. Any suitable mechanism may be employed for this service. In the form of construction shown, a spring plate is used. As shown in Figs. 2 and 3, the piston 34, which is provided with a bottom wall 44, has its side wall extended downwardly beyond said wall and provided with an annular shoulder 45 against which a spring plate 46 is clamped, as by means of the annular clamping member 47.

In operation, a downward thrust movement of the auxiliary cylinder 34 will be initially cushioned by the resilience of the plate 46 which is permitted a slight movement before it comes in contact with the projection or seat 48 on the bottom wall 44 of the piston 34.

The parts are so arranged and proportioned that slightly before or simultaneously with the seating of the plate 46 on the projection 48 the valve member 36 will rise to permit the escape of the liquid into the outer cylinder. Upon rebound the valve member 36 will seat and the liquid will be returned by suction and gravity past the valve 26 into the inner cylinder or valve member 36. A bar 40 within the sleeve member 36 limits the upward movement of the valve and retains it in proper position.

In practice, one or more of the conventional helical springs are replaced by one or more of the units and in order to properly equalize the resistance to the downward movement of the bolster and prevent turning of the same, the units are symmetrically arranged. For instance, if only two of the units are employed for each bolster, one is located at the end of the bolster on the forward side, and the other at the opposite end of the bolster on the rear side.

It is thought from the foregoing taken in connection with the accompanying drawing that the construction and operation of my device will be apparent to those skilled in the art, and that changes in size, shape, proportion and details of construction may be made without departing from the spirit and scope of the appended claims.

I claim as my invention:—

1. In a spring suspension for railway cars, a main cylinder for containing a liquid, an auxiliary cylinder within said main cylinder and containing a liquid, a spring surrounding said auxiliary cylinder and adapted to assist in supporting a car, and means including said spring for controlling the transference of liquid from said auxiliary to said main cylinder upon compression of said unit.

2. In a spring unit for railway car spring suspension, a primary cylinder adapted to contain a liquid, said cylinder having a closed lower end provided with a plate member held in spaced relation to the bottom and side walls of the said plate having an axial opening and a valve seat on its peripheral edge, a hollow piston, an open-ended cylinder within said primary cylinder having an extension on one end engaging said seat and overhanging the same, a spring for resisting the movement of said piston and the unseating of said open-ended cylinder and an inner piston for said last-named cylinder movable with said first-named piston.

3. In a spring unit for railway car spring suspension, a primary cylinder adapted to contain a liquid, said cylinder having a closed lower end provided with a plate member held in spaced relation to the bottom and side walls of the said plate having an axial opening and a valve seat on its peripheral edge, a hollow piston, an open-ended cylinder within said primary cylinder having an extension on one end engaging said seat and overhanging the same, a spring for resisting the movement of said piston and the unseating of said open-ended cylinder, and a resilient metal plate carried by said hollow piston for cushioning the initial compressive forces delivered to said unit.

4. A spring unit for car spring suspension, comprising a pair of telescopic members adapted to contain a liquid, a pair of telescopic elements within said members adapted to contain a liquid, one of said members having a valve seat on which one of said elements is adapted to seat, and a spring for yieldingly resisting the compression of said unit and the unseating of said element.

5. A spring unit comprising a pair of telescopic members, a pair of elements defining a space within said members for containing a liquid, said space being at its maximum when said members are extended and at its minimum when they are compressed, means including one of said elements

for controlling the flow of liquid from said elements into said members when said unit is compressed, and a valved passage through which said liquid is returned when said unit is expanded.

6. A spring unit comprising compressible members adapted to contain a liquid, compressible means within said members adapted to contain a liquid and to be compressed for discharging liquid therefrom into said members when said unit is compressed, and means including a spring for controlling the flow of liquid from said compressible means to said members when said unit is compressed, said spring returning said members to extended position after compression.

7. In a spring suspension for railway cars, a spring unit comprising a reservoir, a cylinder movable relative to said reservoir and adapted to receive a liquid therefrom when the unit expands, a piston for said cylinder, a resilient supporting member for resisting the compression of said unit, means including said cylinder for placing said reservoir in communication with said cylinder for receiving liquid from the cylinder when said unit is compressed, and hydraulic mechanism comprising a valve controlled by said member for resisting the compression of said unit.

8. In a railway car, a truck frame, a truck bolster, a spring assembly for supporting said bolster from said frame, said assembly comprising helical springs and a spring unit operating in parallel, said unit comprising hydraulic mechanism and a resilient supporting member, said mechanism including a cylinder, a reservoir surrounding said cylinder and containing a fluid, a pressure valve and a check valve of restricted area for controlling the flow of said fluid between said reservoir and cylinder for dampening both the compression and expansion movement of said unit.

9. A spring unit for railway car spring suspension, comprising a resilient supporting member and hydraulic mechanism for controlling the compression of said unit, said mechanism comprising a cylinder for containing a liquid, a piston for said cylinder, said piston having an imperforate resilient disk on the end contacting said liquid for cushioning the sudden compression movement of said piston, and means for engaging the central portion of said disk for limiting its inward flexing movement.

DONALD F. SPROUL.

Oct. 30, 1951 J. C. SETTLES 2,573,165

DAMPING MEANS FOR RAILWAY TRUCKS

Filed Feb. 16, 1948 4 Sheets-Sheet 1

Fig. 1

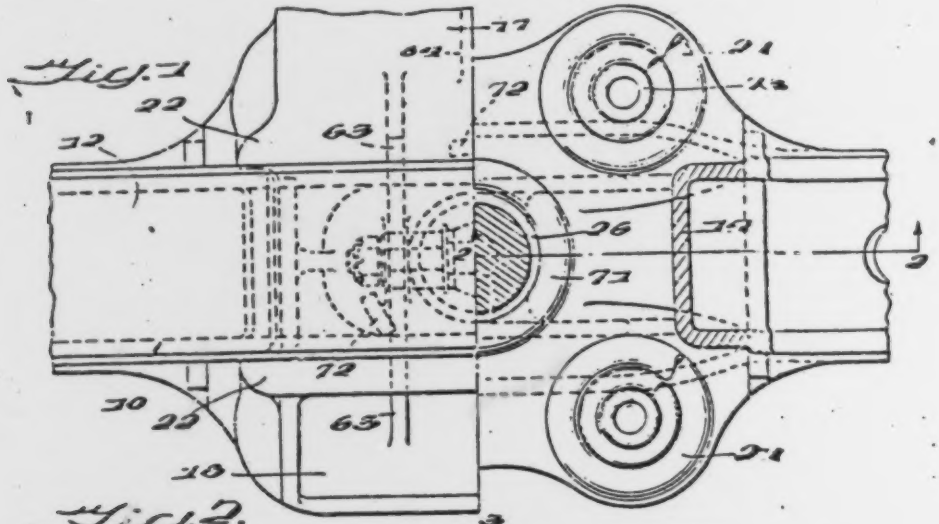
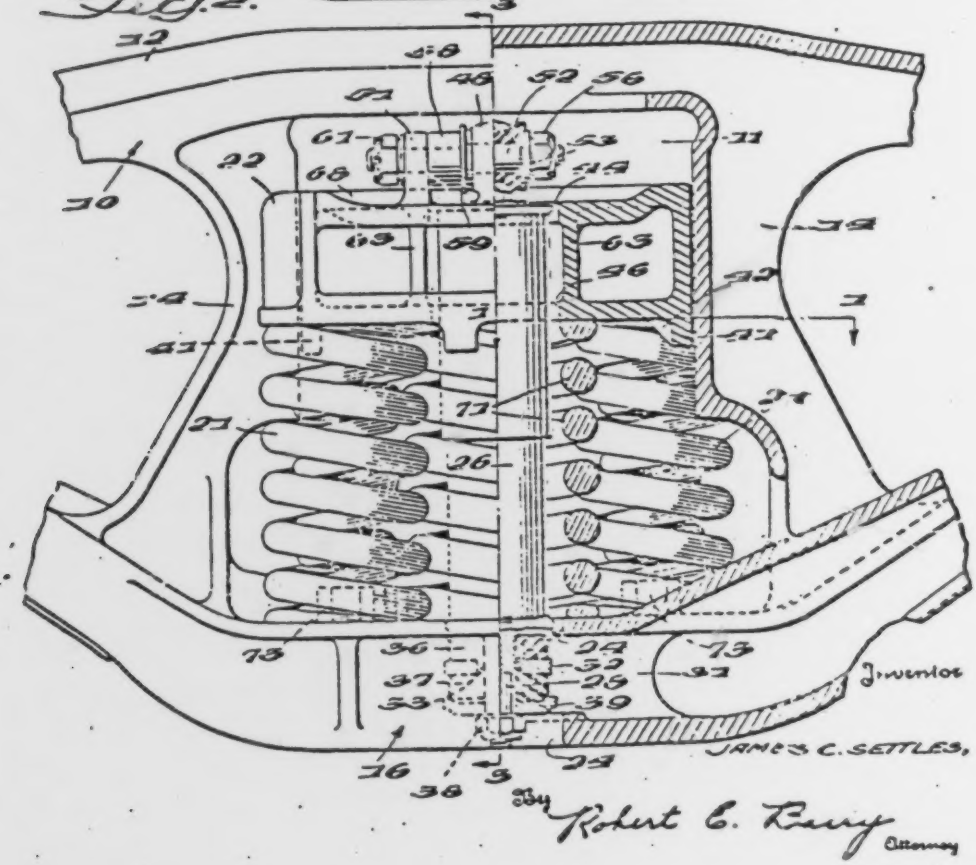


Fig. 2.



Inventor
JAMES C. SETTLES,
By Robert C. Ramy
Attorney

PLAINTIFF'S EXHIBIT 69

Oct. 30, 1951 J. C. SETTLES 2,573,165

DAMPING MEANS FOR RAILWAY TRUCKS

Filed Feb. 16, 1948 4 Sheets-Sheet 2

Fig. 4.

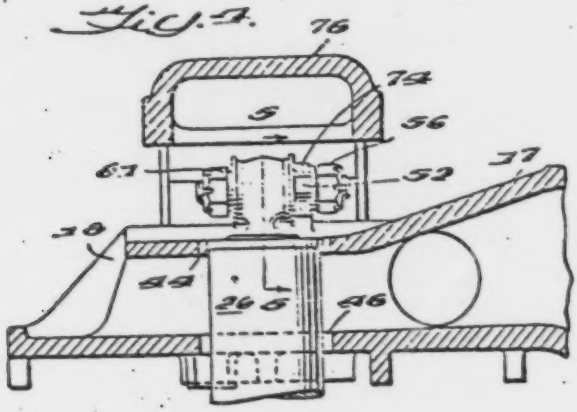


Fig. 5.

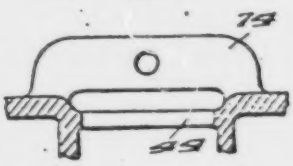
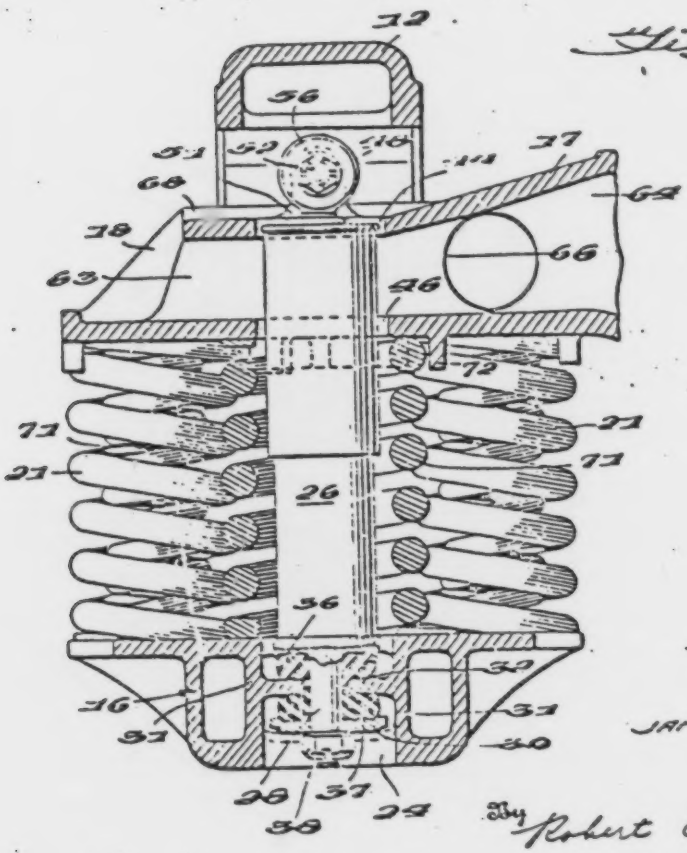


Fig. 3.



Inventor
JAMES C. SETTLES,

By Robert C. Barry
Attorney

Oct. 30, 1951 J. C. SETTLES 2,573,165

DAMPING MEANS FOR RAILWAY TRUCKS

Filed Feb. 16, 1948 4 Sheets-Sheet 3

Fig. 6.

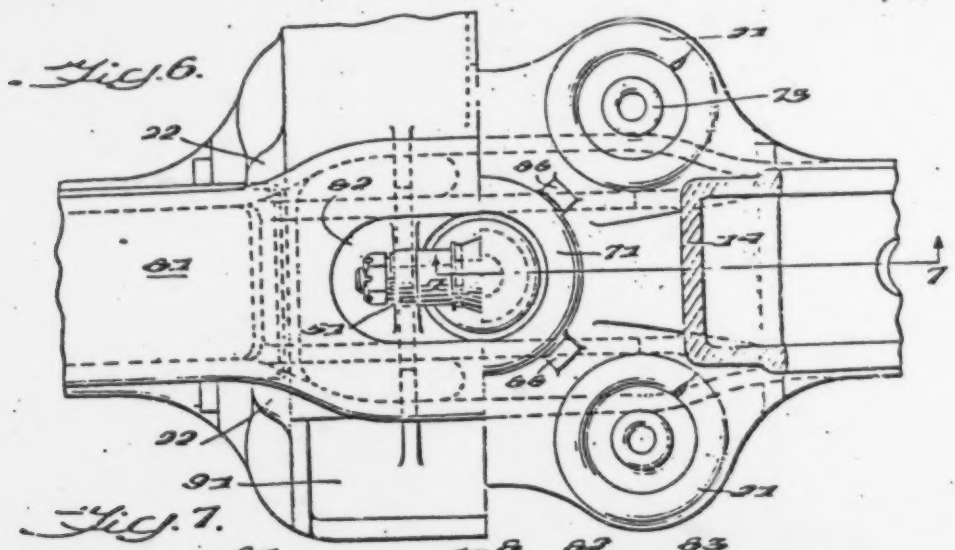
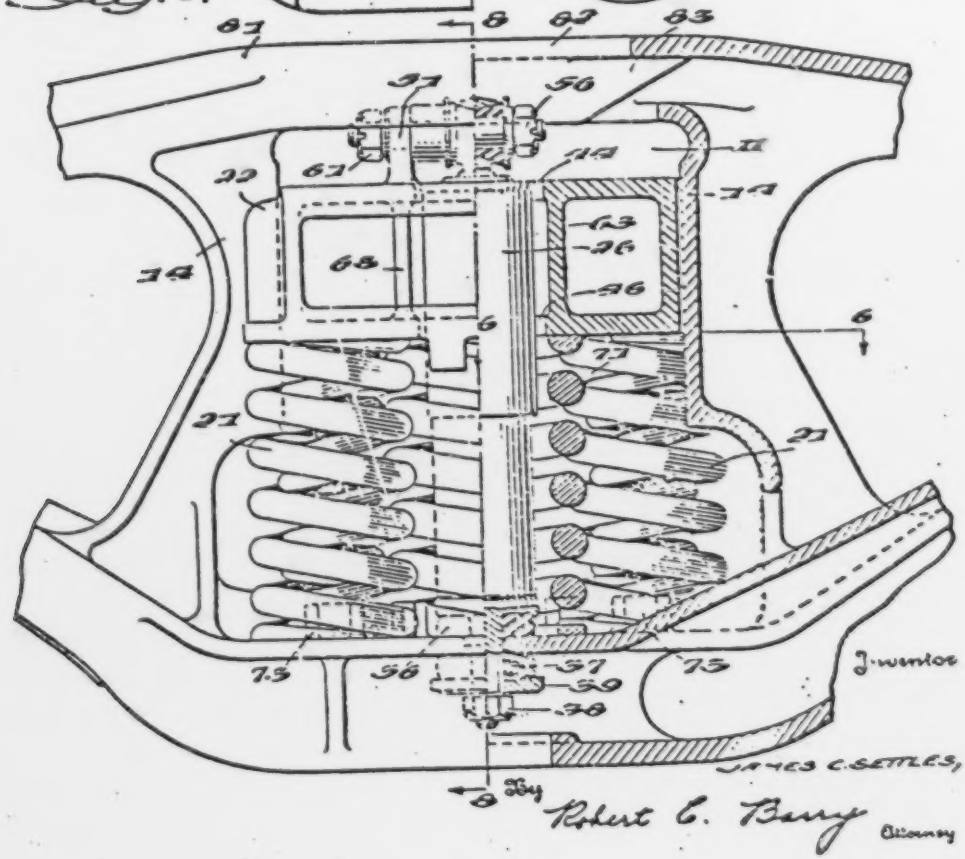


Fig. 7.



Inventor
James C. Settles,
By Robert C. Barry
Attorney

Oct. 30, 1951 J. C. SETTLES 2,573,165

DAMPING MEANS FOR RAILWAY TRUCKS

Filed Feb. 16, 1948 4 Sheets-Sheet 4

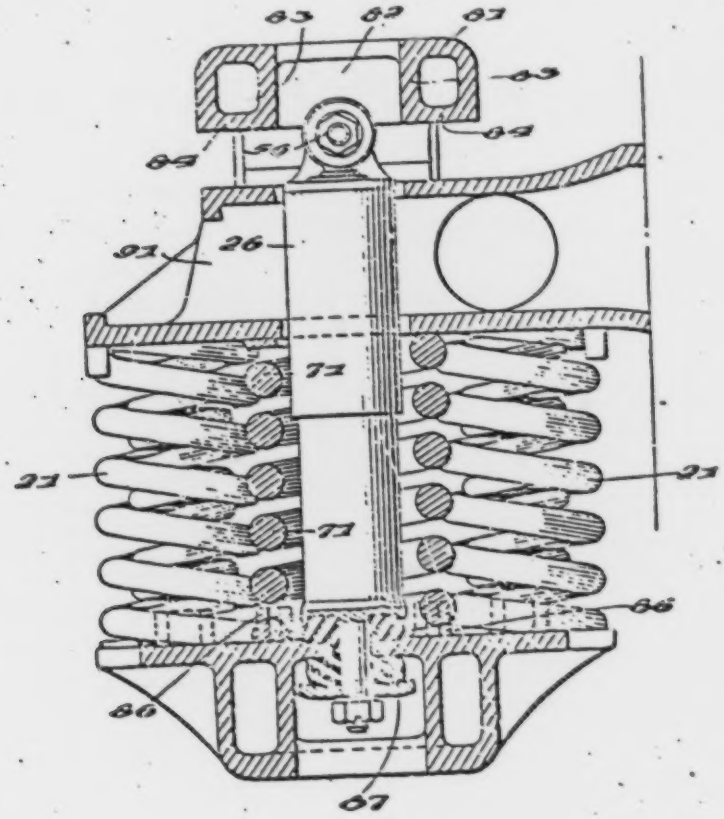


Fig. 6.

Inventor
JAMES C. SETTLES,

By Robert C. Barry
Attorney

Patented Oct. 30, 1951 2,573,165

UNITED STATES PATENT OFFICE

2,573,165

DAMPING MEANS FOR RAILWAY TRUCKS

James C. Settles, Columbus, Ohio, assignor to The Buckeye Steel Castings Company, Columbus, Ohio

Application February 16, 1948, Serial No. 8,701

9 Claims. (Cl. 105—197)

1

The present invention relates to railway car trucks and particularly pertains to means for damping movement of the bolster. The invention is more specifically directed to the position of a hydraulic shock absorber relative to each side frame and the bolster.

In a known damping mechanism, a hydraulic shock absorber has been mounted at the outboard side of the side frame and attached to the end of the bolster by means of a bracket. The spring seat has been constructed to accommodate the lower end of the shock absorber which is then positioned at the outboard side of the bolster supporting springs. Such a construction and position of the shock absorber creates difficulties in the construction of the bolster and side frame and does not provide an assembly which is economical to manufacture and assemble. This prior arrangement of the hydraulic shock absorber also encroached upon the clearance outline defined by the Association of American Railroads. The mounting of the shock absorber in an unprotected position at the outboard side of the side frame also places the damping element in a position to be subject to damage due to flying track ballast in normal operation. The damping assembly further provides a projecting assembly which is disadvantageous in case of accidents.

In such an outboard position of the shock absorber, the damping forces are applied to the side frame at a considerable distance outwardly of the center line of the supports of the frame on the journals. These forces produce moments which tend to rotate the side frame about its supports on the axle journals. This condition is more pronounced and undesirable in spring plankless type trucks wherein the opposite side frames are not joined at the spring seat level by a spring plank and are accordingly free to rotate under the action of the shock absorber forces.

It is an object of the present invention to remove such disadvantages by positioning the hydraulic shock absorber at the intersection of the longitudinal center line of the side frame with the longitudinal center line of the bolster.

A further object of the invention resides in providing side frame and bolster constructions which are adaptable for mounting the shock absorber on the side frame and attaching it to the

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bolster and facilitating the removal of the shock absorber in dismantling the truck assembly and at the same time providing a railway truck having adequate strength for carrying the loads imposed on these portions of the truck.

Other objects and features of the invention will be more apparent to those skilled in the art as the present disclosure proceeds and upon consideration of the following detailed description and the accompanying drawings wherein several exemplary embodiments of the invention are disclosed.

In the drawings:

Fig. 1 is a plan view in the left hand portion showing a railway car truck exhibiting the invention while the right hand portion is a section taken on the line 1—1 of Fig. 2.

Fig. 2 in the left hand portion is a side elevational view of a part of the railway truck with the right hand portion depicting a section taken on the line 2—2 of Fig. 1.

Fig. 3 is a vertical section of the bolster and the side frame taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary vertical section of the bolster end and a portion of the side frame showing a modification.

Fig. 5 is a fragmentary sectional view taken on the line 5—5 of Fig. 4 with parts of the shock absorber omitted.

Fig. 6 in the left hand portion is a plan view of another modification while the right hand portion is a sectional view taken on the line 6—6 of Fig. 7.

Fig. 7 in the left hand portion is a side elevational view while the right hand portion is a section taken on the line 7—7 of Fig. 6.

Fig. 8 is a sectional view taken on the line 8—8 of Fig. 7.

The present invention is directed to an arrangement of a shock absorber of the liquid or hydraulic type in a general vertical plane defined substantially by the intersection of the longitudinal center line of the side frame with the longitudinal center line of the bolster. This position of the shock absorber removes the tendency of any turning moments resulting from the forces produced by the shock absorber tending to rotate the side frame about its supports on the journals and also applies the damping forces to the center line of the bolster.

Referring to the drawings, there is shown at 10, a side frame of usual construction having a central bolster opening 11 and a top compression member 12. The side frame includes bolster guide columns 14 and a spring seat 16 forming a part of the tension member of the side frame. The spring seat may be of box construction, as shown particularly in Fig. 3.

A bolster 17 is provided with an end portion 18 which extends into the bolster opening 11 and is supported on a plurality of helical springs 21. These springs rest at their lower ends on the spring seat 16 and the load carried by the bolster is thereby supported by the springs 21. The end portion of the bolster may be provided with lugs 22 as shown in Figs. 1 and 2, which embrace the bolster guide columns 14 at each side of the bolster opening in the usual manner.

The spring seat portion of the tension member is provided with an opening 24 arranged midway between the bolster guide columns 14 and with the axis of this opening aligned with the center line of the side frame. This opening 24 extends through the box section of the spring seat member. The opening 24 is provided for receiving the lower end portion of a liquid or hydraulic type shock absorber of a well-known construction represented at 26 in the drawings. The lower end portion of the shock absorber 26 is provided with a stem 28. A pair of spaced walls 31 extend longitudinally of the spring seat member and define the inboard and outboard dimensions of the opening 24. These walls join the top and bottom webs of the box-shaped spring seat member for reinforcing this portion of the side frame and in the region of the opening 24. A horizontal web 32 having a central opening 33 extends between the spaced walls 31 to form part of means for the attachment of the stem 28 of the shock absorber to the tension member of the side frame. The vertical location of the web 32 with reference to the spring seat member may be varied to accommodate the particular shock absorber and the springs employed in the car truck. The lower end of the shock absorber is attached to the tension member by means of resilient bushings 36 and 37 which are arranged on opposite sides of the horizontal web 32 and by means of a nut 38 threaded onto the stem 28. A washer 39 may be interposed between the nut 38 and the resilient bushing 37.

The end portion 18 of the bolster 17 is desirably of box section and may be provided with side wall extensions 41 braced by ribs 42 to increase the column bearing area, as shown in Fig. 2. An opening 44 is provided in the top wall of the bolster aligned with an opening 45 in the bottom wall of the bolster. The axis of these two aligned openings is arranged in a vertical plane coinciding with the longitudinal center of the bolster 17. These openings 44 and 45 are provided for the upper end portion of the hydraulic shock absorber 26. The upper end of the hydraulic shock absorber carries a loop 48 and this loop is of sufficiently small overall dimensions to pass through the openings 44 and 45.

The upper end of the shock absorber 26 is attached to the bolster 17 by means of a bracket 51 rigidly attached to, or forming a part of, the bolster and arranged at one side of the aligned openings 44 and 45, as shown in Fig. 2. The loop 48 is attached to the bracket 51 by means of a bolt 52 which extends through the loop 48 and an aperture in the bracket 51. A resilient bushing 53 may be provided between the nut 56 and the loop 48. A spacer element 58 may be provided between the bracket 51 and the loop 48. Another resilient bushing 59 may be interposed between the loop 48 and the spacer element 58. Another nut 61 completes one type of means for attaching the shock absorber to the bolster.

The bracket 51 is positioned at one side of the openings 44 and 45 in the bolster to facilitate assembly of the parts and this bracket is then positioned so that the attachment assembly at the top of the bolster including the bracket 51 may enter the inverted channel in the compression member 12 of the side frame when the bolster is raised in the bolster opening 11 to apply or remove the springs 21 or for other purposes such as in shimming the assembly. The bolster in the region of the openings 44 and 45 may be reinforced by a plurality of longitudinal ribs 63 which connect the top and bottom walls of the bolster. One of these ribs 63 is provided on each side of the openings 44 and 45. The ribs 63 extend inwardly beyond the openings 44 and 45 and terminate at 64 adjacent a point where the central bolster rib 14 starts.

The bracket 51 is arranged to extend upwardly from the top wall of the bolster and is positioned at the side of the opening 44, as hereinabove described. If necessary, the top wall of the bolster may be depressed, as indicated at 68 to provide additional clearance for applying and removing the nuts 56 and 61. This depressed portion of the top wall of the bolster extends through the central portion as will be evident upon consideration of Fig. 2. This arrangement does not, therefore, reduce the column bearing areas of the bolster.

If desirable, and if required for carrying the load imposed on the bolster, a helical spring 71 may be positioned around the shock absorber 26. The spring 71 is maintained in a spaced relationship around the shock absorber by means of a plurality of lugs 72 which depend from the bolster and prevent lateral displacement of the spring 71. This arrangement of the lugs 72 facilitates assembly of the shock absorber and the spring 71 on the truck. The other load supporting springs 21 may be maintained in proper position by central circular spuds 73 projecting upwardly from the spring seat, as shown in Fig. 2. If desired, the usual spring plates may be used at the top and the bottom of the load supporting springs in which case the spring positioning means would be formed on the spring plates rather than carried by the bolster and the side frame castings.

In assembling the shock absorber and the bolster in proper position on each side frame, the bolster is first raised to the top of the bolster opening 11. Thereafter the shock absorber 26 is compressed to its minimum length. The shock absorber is then arranged within the spring 71 and this spring and the shock absorber is tilted or arranged at an angle and moved in this position into the bolster opening. Thereafter, the top portion of the shock absorber or the loop 48 is passed upwardly through the openings 45 and 44 in the end portion 18 of the bolster. The top portion of the shock absorber is raised until the loop 48 extends into the inverted channel of the compression member 12. With the parts in this position, the lower end of the shock absorber is then swung into the bolster opening. During this

operation the stem 28 arranged on the lower end of the shock absorber is lowered to pass through the opening in the horizontal web 32. The resilient bushing 36 is preferably applied on the stem 28 before the introduction of this part into the opening in the spring seat. The resilient bushing 37 may then be applied and the nut 38 is then threaded onto the stem 28. The resilient bushing 37 and the washer 39 and the nut 38 can be arranged on the stem 28 through the opening 34. The bolt 52 and the associated parts may then be applied to the loop 48 to connect the upper end of the shock absorber to the bracket 51.

The coil springs 21 at the inward positions or those toward the inboard side of the side frame may be applied before the shock absorber is arranged in position. The coil springs 21 at the outboard side of the side frame are preferably arranged in position after the shock absorber is positioned within the bolster opening. The upper end of one spring 71 will swing into position between the positioning lugs 72 as the shock absorber is applied in the manner as hereinabove described.

It will be observed that the hydraulic shock absorber 26 is arranged at the intersection of the center line of the bolster 17 with the center line of the side frame. Accordingly, the damping forces of the shock absorber do not set up any reaction moments tending to shift or twist the side frame from its proper position with respect to the journals. The shock absorber is, furthermore, located within the nest of springs so as to be protected from flying ballast and the assembly does not create any problems with reference to clearance in that the damping means is located within the side frame and does not project beyond the normal position of the side frame parts.

In the modification shown in Figs. 4 and 5, a bracket 74 is positioned on the inboard side of the openings 44 and 46 in the bolster. The attachment of the shock absorber to the bracket 74 is made in the same manner as that described with reference to the embodiments shown in Figs. 1 to 3, except that the bolt 52 extends longitudinally of the bolster instead of transversely thereto. Under some conditions of clearance, this construction and arrangement of the bracket 74 may be preferred for facilitating the application of the nuts 56 and 61 to the bolt 52. In this form of the invention, the compression member 76 is wider than that of the previous construction to permit the bracket 74 and the attaching means to enter the inverted channel in the compression member 75 when the bolster is raised to the top of the bolster opening.

In the embodiment illustrated in Figs. 6, 7 and 8, the compression member 81 of the side frame is widened over the bolster opening 11 and is provided with an aperture 82 through which the shock absorber 26 may be applied and removed from the side frame. The compression member is provided with spaced longitudinal walls 83 at each side of the opening 82 to reinforce the top member of the side frame in the vicinity of the opening 82. Horizontal webs 84 are provided between the lower ends of the walls 83 and the side walls of the compression member to further reinforce this portion of the side frame. In this modification, the coil spring 71 is maintained in proper spaced relationship around the shock absorber 26 by means of a plurality of lugs 86 which extend upwardly from the spring seat member.

As shown in Figs. 7 and 8, the horizontal web provided on the spring seat member is raised to the level of the top wall of the spring seat member and is indicated at 87 in Fig. 8. A deeper bolster end 91 may be used in this structure than that of the previous embodiments and it may not be necessary to extend the side walls below the box section to obtain adequate column bearing area.

While the invention has been described with reference to specific structural details, it will be understood that changes may be made in the assembly and in the elements thereof such as the type of hydraulic shock absorber and the manner in which the absorber is attached to the side frame and the bolster. Such changes and others may be made without departing from the spirit and scope of the invention, as set forth in the appended claims.

What I claim and desire to secure by Letters Patent is:

1. In a railway car truck, a side frame including a compression member having an intermediate portion of inverted channel-shape, said side frame having a centrally arranged bolster opening therein, a spring seat box-shaped in cross section forming a part of the side frame and having top and bottom walls, said bottom wall having an opening therein, ribs arranged longitudinally of the side frame within the spring seat joining the top and bottom walls defining the sides of the opening in the bottom wall, a bolster having a box-shaped end portion extending into the bolster opening, springs supporting the bolster on said spring seat, an elongated hydraulic shock absorber, a stem carried by the lower end of said shock absorber, means securing the stem to the spring seat including a nut accessible through the opening in the bottom wall of the spring seat, said bolster having an opening in the bottom wall thereof and an aligned opening in its top wall both of diameters large enough to receive an upper end portion of the shock absorber, a loop member carried by the upper end of the shock absorber, a bracket above and rigid with the top wall of the bolster and arranged at one side of the openings in the bolster, means extending through the bracket and the loop member connecting the upper end of the shock absorber to said bracket, ribs joining the top and bottom walls of the bolster extending longitudinally therein and arranged at opposite sides of the openings in the top and bottom walls, a centrally disposed rib joining the top and bottom walls of the bolster positioned inwardly of the inner ends of the first ribs, and said bracket and loop member being of such lateral dimensions as to be accommodated within the channel of the compression member when the bolster is raised in the bolster opening.

2. In a railway car truck, a side frame, said side frame having a bolster opening therein, a spring seat box-shaped in cross-section forming a part of the side frame and having top and bottom walls, said bottom wall having an opening therein, ribs arranged longitudinally of the side frame within the spring seat joining the top and bottom walls at an inboard and outboard side of the opening in the bottom wall, a horizontal web joining said ribs below the top wall of the spring seat, said web having an opening therein, a bolster having a box-shaped end portion extending into the bolster opening, helical springs supporting the bolster on said spring seat, an elongated hydraulic shock absorber, a stem carried by the lower end of the shock absorber extending through the opening in said web, means accessi-

ble through the opening in the bottom wall of the spring seat for securing the stem to said web, said bolster having an opening in the bottom wall thereof and an aligned opening in the top wall both of a diameter large enough to receive the upper end portion of the shock absorber, a loop member carried by the upper end of the shock absorber, a bracket rigid with the top wall of the bolster, means extending through the bracket and the loop member connecting the upper end of the shock absorber to said bracket, means within and reinforcing the bolster in the vicinity of the openings in the top and bottom walls, and the top wall of the bolster having a depressed portion in the region of the bracket and upper end of the shock absorber.

3. In a railway car truck, a side frame including a compression member, said side frame having a bolster opening, a spring seat box-shaped in cross section including top and bottom walls, said bottom wall having an opening therein, ribs arranged longitudinally of the spring seat joining the top and bottom walls and providing inboard and ouboard walls for the opening in the bottom wall of the spring seat, a bolster having a box-shaped end portion including top and bottom walls extending into the bolster opening, springs supporting the bolster on said spring seat, an elongated hydraulic shock absorber, means for securing a lower end of the shock absorber to the spring seat including a nut accessible through the opening in the bottom wall of the spring seat, said bolster having an opening in the bottom wall thereof and an aligned opening in the top wall both large enough to receive the upper end of the shock absorber, a loop member carried by the upper end of the shock absorber, a bracket rigid with the top wall of the bolster, means connecting the loop member to the bracket to secure the upper end of the shock absorber to the bolster, means reinforcing the bolster in the vicinity of the bracket, and said compression member having an opening vertically therethrough of larger area than the cross section of the shock absorber.

4. In a bolster for a railway car truck, a top wall, a bottom wall, side walls connecting the top and bottom walls, said top wall having an opening therethrough, said bottom wall having an opening therethrough vertically aligned with and of substantially the same size as the opening in the top wall, vertically disposed ribs extending longitudinally within the bolster joining the top and bottom walls at opposite sides of said openings, and a bracket carried by the top wall at one side of the opening therein for attachment to a bolster damping means extending through said openings.

5. In a bolster for a railway car truck, a top wall, a bottom wall, side walls connecting the top and bottom walls, said top wall having an opening therethrough, said bottom wall having an opening therethrough vertically aligned with and of substantially the same size as the opening in the top wall, vertically disposed ribs extending longitudinally within the bolster joining the top and bottom walls at opposite sides of said openings, a bracket carried by the top wall at one side of the opening therein for attachment to a bolster damping device extending through said openings, and said bracket being vertically aligned with one of said ribs.

6. In a bolster for a railway car truck, a top wall, a bottom wall, side walls connecting the top and bottom walls, said top wall having an opening therethrough, said bottom wall having an opening therethrough vertically aligned with and of substantially the same size as the opening in the top wall, vertically disposed ribs extending longitudinally within the bolster joining the top and bottom walls at opposite sides of said openings, a bracket carried by the top wall at one side of the opening therein for attachment to bolster damping means extending through said openings, and said top wall having a depressed area in the upper surface in a region surrounding the bracket and the opening in the top wall.

7. In a railway car truck, a side frame, said side frame having a bolster opening therein, a spring seat box-shaped in cross section forming a part of the side frame and having top and bottom walls, said bottom wall having an opening therein, ribs arranged longitudinally of the side frame within the spring seat joining the top and bottom walls at the inboard and outboard sides of the opening in the bottom wall, a bolster having a box-shaped end portion extending into the bolster opening, springs supporting the bolster on said spring seat, an elongated hydraulic shock absorber, means securing a lower end of the shock absorber to the spring seat including a nut accessible through the opening in the bottom wall of the spring seat, said bolster having an opening in the bottom wall thereof of a diameter large enough to receive an upper end portion of the shock absorber, a bracket rigid with the top wall of the bolster, means connecting the upper end of the shock absorber to said bracket to secure the upper end of the shock absorber to the bolster, and means within and reinforcing the bolster in the vicinity of said bracket.

8. A side frame for a railway car truck comprising, a compression member, a tension member including a spring seat of box-shaped section throughout the length of the spring seat and having top and bottom walls, said bottom wall of the spring seat having an opening therein, vertically disposed ribs within the box-shaped spring seat extending longitudinally thereof throughout a major portion of the length of the spring seat joining the top and bottom walls and providing two spaced box-shaped sections throughout a central portion of the spring seat, said ribs defining the inboard and outboard boundaries of the opening in the bottom wall, and said top wall of the spring seat having an opening therein with the axis thereof aligned with the axis of the opening in the bottom wall of the spring seat.

9. A side frame for a railway car truck comprising, a compression member including depending side walls throughout an intermediate portion thereof, a tension member including a spring seat of box-shaped section throughout the length of the spring seat and having top and bottom walls, guide columns connecting the tension member and the compression member defining a bolster opening, said bottom wall having an opening therein, vertically disposed ribs within the box-shaped spring seat extending longitudinally thereof throughout a major portion of the length of the spring seat joining the top and bottom walls thereof and providing two spaced box-shaped sections throughout a central portion of the spring seat, said ribs defining inboard and outboard boundaries of the opening in the bottom wall, said top wall of the spring seat having an opening therein with the axis thereof aligned with the axis of the opening in the bottom wall of the spring seat, said compression member having an opening vertically disposed therethrough in a portion over the bolster open-

ing, and a vertically disposed wall depending from the compression member at each side of the opening therein and extending lengthwise of the frame between the guide columns.

JAMES C. SETTLES.

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SELF-ADJUSTING STABILIZER FOR SPRING SUSPENSION

Filed Sept. 17, 1957 2 Sheets-Sheet 1

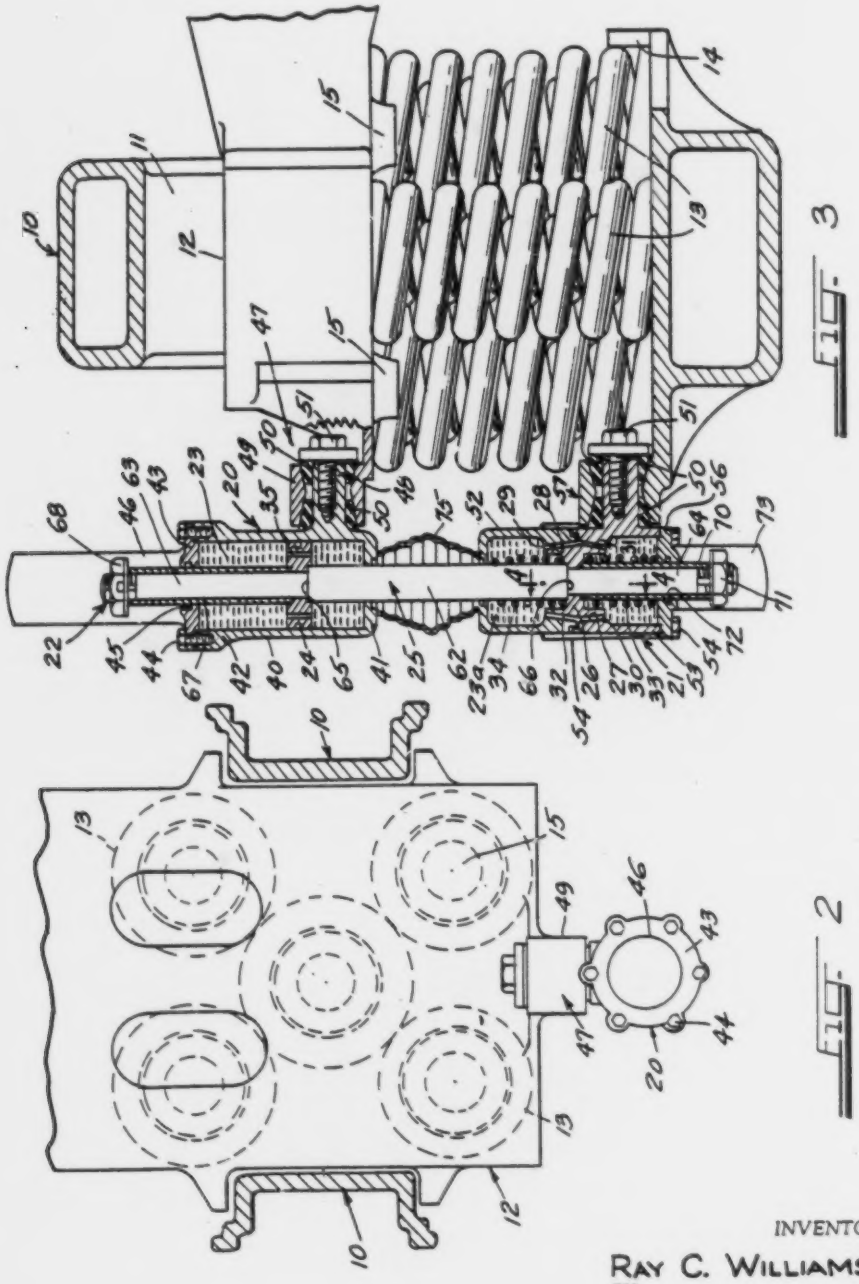

FIG. 3

FIG. 2

INVENTOR.

RAY C. WILLIAMS

BY

Harvey M. Gillespie

Atty.

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SELF-ADJUSTING STABILIZER FOR SPRING SUSPENSION

Filed Sept. 17, 1957 2 Sheets-Sheet 2

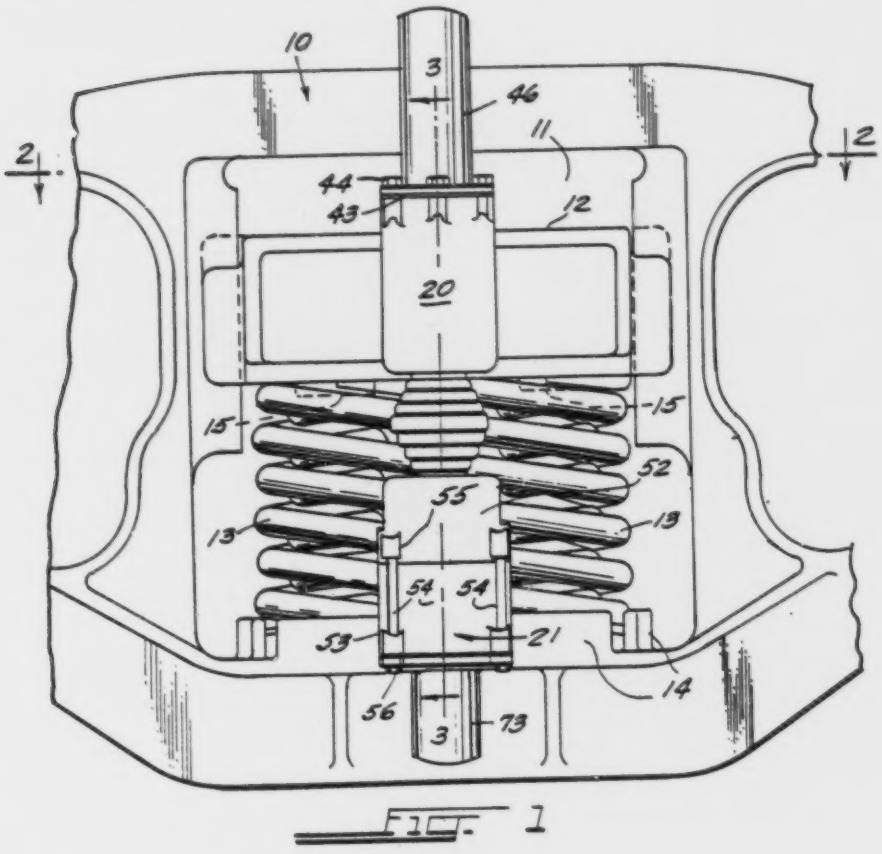

FIG. 1

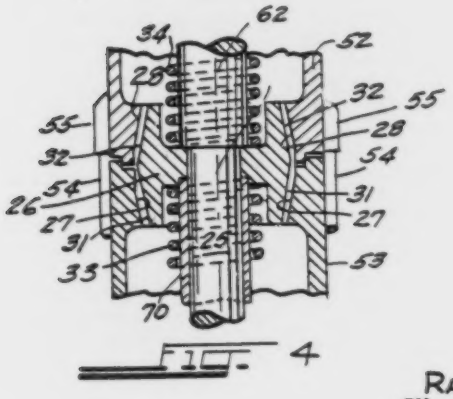

FIG. 4

INVENTOR.
RAY C. WILLIAMS
BY
Harvey M. Gillespie
ATT'Y.

United States Patent Office

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SELF-ADJUSTING STABILIZER FOR SPRING SUSPENSION

Ray C. Williams, Chicago, Ill., assignor to Standard Car Truck Company, Chicago, Ill., a corporation of New Jersey

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2 Claims. (Cl. 267—8)

The present invention relates to an improved self-adjusting stabilizing mechanism for a spring suspension. It has been designed for use as a means for stabilizing the undulations of the spring suspension structure of a railway car truck whereby the indulations of a set of load supporting springs are effectively damped. It is to be distinctly understood however that the invention is capable of other uses and the present stabilizing mechanism will be found useful in connection with motor vehicle or trailer suspension system, shock absorber means for aircraft landing gear or, in fact in connection with the damping of spring oscillations of objectional amplitudes, between two relatively movable bodies which are subjected to forces tending to move them relative to each other. Irrespective however of the particular use to which the present invention may be put, the essential features thereof are at all times preserved.

Spring suspension devices which are provided with friction type snubbing means employing friction shoes and cooperating wear plates for damping the oscillations between two relatively movable bodies, and especially variable load carrying bodies such as the bolster of a railway freight car for example which must be resiliently supported at each end from the car truck frame, are subject to variations in their operating characteristics, depending upon the initial load applied to the bolster at the time of any given run. The helical type of spring which is widely employed for supporting the weight of the railway freight car is quite satisfactory for this purpose but it is subject to harmonic vibrations in more or less direct proportion to the initial load, such vibrations being occasioned by various factors as for example when the ends of the rails are slightly elevated or depressed and the speed is such as to cause the wheel treads to move over the rail joints at a rate commensurate with the natural period of vibration of the spring assembly. In such an instance the vibrations will build up inordinately, particularly if the car is heavily loaded, sometimes to an extent which is beyond the ability of the snubbing devices associated with the spring suspension to assimilate them so that the springs will go solid and break or otherwise damage the frame. In other words, conventional snubbing devices associated with such spring assemblies are effective only throughout a predetermined range of vibrational amplitudes and, when the car is initially heavily loaded the springs are subjected to an initial displacement or deformation which remains permanent as long as the load is present. This initial displacement brings the friction shoes and their associated wear plates well into their effective working range at the outset so that when subsequent harmonic vibrations become effective as previously described, the peaks of such vibrations, i.e. the relatively large displacement amplitudes, will tend to either move the shoes and wear plates out of register or to cause them to jam so that the friction snubbing devices do not have the ability to dampen such vibrations and the springs will reach the limit of their free elasticity and go solid.

The present invention is designed to overcome the above noted limitations that are attendant upon the use of conventional friction type stabilizing devices and, toward this end, it contemplates the provision of a novel

form of hydraulic snubbing or vibration dampening means which may be operatively associated with a wide variety of spring suspension assemblies and which has the necessary capacity and will operate under all conditions of load to prevent harmonic vibrations of the assembly. According, it is among the principal objects of the present invention to provide a vibration dampening means which will, at the outset and regardless of the applied load, assume a neutral condition with the snubbing element of the dampening means being positioned substantially at the exact center of its effective snubbing stroke so that whenever vibrational effects are encountered, in either direction of displacement, the snubbing element will be immediately effective to apply its full snubbing action without moving out of its snubbing range.

In carrying out the above mentioned object, the invention contemplates the provision of a snubbing means which is essentially hydraulic in its operation, depending as it does upon the resistance offered by a solid column of a liquid to the snubbing member proper. Briefly, the invention provides a first hydraulic piston and cylinder assembly wherein the piston is interposed between two solid columns of liquid and through which piston the liquid is capable of being bled uniformly from one side of the piston to the other so that only gradual piston displacements are possible. The cylinder is bodily movable with the bolster to which it is rigidly attached. A second hydraulic piston and cylinder assembly wherein the piston is likewise interposed between two solid columns of liquid is also provided and the cylinder of this latter assembly is fixedly secured to and moves bodily with the truck frame. The second piston constitutes the snubbing element per se and this piston has associated therewith automatically operable valve means whereby the bleeding action across the piston from one column of liquid to the other is regulated in proportion to the extent of its displacement from a medial or mean position within the cylinder in which it operates.

While the first piston may exert some snubbing action limiting sudden relative displacements between the bolster and truck frame, its primary function is of an equalizing nature wherein the application of a load to the bolster or the removal of a load from the bolster tending to lower or elevate the bolster on its support, i.e. the truck frame, will, by a bleeding of the liquid from one side of the piston to the other, cause the piston to seek an equalized position within its respective cylinder.

The two pistons are rigidly connected together so that they move in unison and means are provided for yieldingly biasing the piston of the second piston and cylinder assembly so that it will assume its mean or medial position in the cylinder. By such an arrangement, it follows that since the two columns of liquid on opposite sides of each piston are capable of being bled through or around the piston, the biasing means will under all static conditions of the bolster and car truck be effective to urge the two rigidly connected pistons to positions of equilibrium in the hydraulic system, regardless of the imposed load on the bolster. In other words, a new load on the bolster will merely effect a new position of equilibrium for the two pistons as a unit, and in each position of equilibrium, the second or snubbing piston per se will assume its medial or mean position.

With the second or snubbing piston in this medial or mean position within its respective cylinder, it is at all times, regardless of the load or lack of load, maintained in readiness for immediate snubbing operation within the working range of which it is capable whenever sudden vibrational effects are encountered which it is desired shall be nullified or otherwise rendered harmless. Because of the automatic valve action previously mentioned, and the nature of which will be set forth fully herein-

after, the extent of the snubbing action presented by the snubbing piston will be substantially directly proportionate to the demand for such snubbing action as evidenced by the amplitude of displacement between the bolster and car truck from any given relative position of equilibrium.

The provision of a stabilizing mechanism of the character briefly outlined above being among the principal objects of the invention, it is a further object to provide a device of this sort which is effectively sealed against the entrance of dirt or other foreign material into the operative working parts thereof, either hydraulic or mechanical, and which will remain thus effectively sealed throughout the entire life of the mechanism.

A still further object of the invention, in a mechanism of this character, is to provide a stabilizing mechanism which may be readily applied to existing installations and which, for this purpose, is capable of immediate application to the two relatively moving bodies without requiring preliminary adjustment or fitting of parts and which furthermore, when so applied, will assume a condition for immediate use with the snubbing mechanism associated with the assembly assuming its neutral condition automatically as previously described.

The provision of a stabilizing apparatus which is relatively simple in its construction and which therefore may be manufactured at a low cost; one which is rugged and durable and which therefore is possessed of a relatively long life; one which is comprised of a minimum number of moving parts and which therefore is unlikely to get out of order; one which when assembled and installed in a desired environment is readily accessible for purposes of inspection, disassembly for replacement of parts or repair if necessary, and one which otherwise is well adapted to perform the services required of it, are further desirable features which have been borne in mind in the production and development of the present invention.

Other objects and advantages of the invention, not at this time enumerated, will become readily apparent as the following description ensues.

In the accompanying two sheets of drawings forming a part of this specification a preferred embodiment of the invention has been shown.

In these drawings:

FIG. 1 is a fragmentary side elevation view of an improved stabilizing device constructed in accordance with the principles of the present invention, showing the same operatively installed by way of example between a railway car truck frame and an associated bolster the movements of which it is desired to dampen.

FIG. 2 is a sectional view taken substantially along the line 2—2 of FIG. 1.

FIG. 3 is a sectional view taken substantially along the line 3—3 of FIG. 1 with the load springs of the car truck and the truck bolster being shown in elevation, and

FIG. 4 is an enlarged detail sectional view taken substantially on line 4—4 of FIG. 3.

Referring now to the drawings in detail, the side frame of a railway car truck is designated in its entirety at 10 and is provided with the usual bolster window 11 therein for reception of one end portion of a bolster 12. The bolster 12 is yieldingly supported by a group or nest of relatively heavy coil springs 13 which are maintained seated at their lower ends on the frame 10 by means of upstanding lugs or flanges 14 and at their upper ends by means of suitable centering lugs 15. The side frame 10 is provided at its opposite ends with the usual arrangement of supporting wheels (not shown) which cooperate with a similar arrangement of wheels and associated parts at the opposite side of the car truck and by means of which the truck may be supported on rails from the traction surface or ground. The arrangement of parts thus far described is more or less conventional in its design and it will be understood that any load which may be applied to the railroad car is in turn applied to the bolster 12 and from thence distributed through the load springs to the side frame 10. The load springs 13 are, of course, compressed in direct proportion to the applied load and, during operation of the car, these springs are subject to the usual vibrational effects as the car wheels pass over the rail joints or other irregularities in the roadbed surface and which vibrational effects it is desired to dampen according to the present invention.

The details of the present stabilizing system are best illustrated in FIG. 3 wherein there is shown an upper hydraulic equalizing cylinder assembly 20 operatively and fixedly secured to the bolster 12 for movement bodily therewith, a lower hydraulic snubbing cylinder assembly 21 operatively and fixedly secured to the side frame 10 for movement bodily therewith, and an interconnecting thrust rod or plunger assembly 22. Briefly, and as will be described in greater detail presently, the upper cylinder assembly 20 serves to confine a column or body 23 of an incompressible liquid so that the liquid is constrained to move bodily with the cylinder assembly and transmit its vertical movements to an hydraulic piston 24 mounted on a thrust rod proper 25. The thrust rod 25 carries a combined snubbing piston and valve member 26 which is disposed and operates within the lower snubbing cylinder containing a body of the liquid designated 23a. The said value member 26 cooperates with a pair of adjacent frusto-conical valve surfaces 27 and 28 when the thrust rod 25 is displaced in a downward or an upward direction respectively. The upper frusto-conical surface 28, in effect, defines a valve port 29 and the lower frusto-conical surface 27 defines, in effect, a valve port 30, the said piston or valve member 26 operating between the two ports and having frusto-conical surfaces 31 and 32 (FIG. 4) opposing the two surfaces 27 and 28.

The piston and valve member 26, which will hereinafter be referred to as the valve piston, is normally and yieldingly maintained in a "neutral" position of equilibrium out of contact with either surface 27 or 28 midway between the two ports 29 and 30 by means of a pair of biasing springs 33 and 34 which center the piston, so to speak, between the two frusto-conical surfaces 27 and 28 but which yield to permit cooperating valve action with either surface when undesired displacements in either direction are encountered. Movement of the valve piston 26, under the influence of its biasing springs 33 and 34 to its neutral position of equilibrium is made possible by virtue of one or more bleeding apertures 35 provided in the equalizing piston 24 whereby the liquid 23 may be gradually bled from one side of the piston to the other and whereby initial compression of the coil springs 13 or expansion thereof under the influence of loading or unloading respectively of the railway car will cause the biasing springs 33 and 34 associated with the valve piston 26 to relieve themselves gradually of any compressional forces which may be applied thereto so that these springs will ultimately bring the valve piston 26 to its neutral position regardless of the initial load involved. Such is the general nature and operation of the present stabilizing mechanism of the present invention and it remains merely to describe in more detail some of the operating instrumentalities associated therewith so that a full understanding of the invention may be had.

Referring now to FIG. 3, the upper hydraulic cylinder assembly 20 comprises an upright cup-shaped cylinder block 40 having a base portion 41 through which the thrust rod assembly 22 extends and having an upper thickened rim portion 42 which is closed by means of a closure plate 43 held in position on the rim by studs 44. The thrust rod assembly 22 likewise projects through the closure plate 43 and is sealed for sliding movement therein by a conventional sealing gland 45. A dust cap 46 serves to exclude dirt or other foreign material from the gland 45. The cylinder is attached to the bolster 12 through a flexible connection 47 which permits limited angular movement between the two parts to compensate

for lengthwise movement of the bolster while at the same time constraining the cylinder to follow the vertical movements of the bolster. This connection is in the form of a stud-like projection 48 which may be integrally formed on the cylinder block 40 and which is centered within a a tubular eyelet or boss 49 integrally formed on the bolster by means of a pair of rubber or other resilient mounting sleeves 50. The various parts are held in position by stud and washer assemblies 51.

The lower snubbing cylinder assembly 21 comprises a composite inverted cup-shaped block assembly comprising upper and lower block sections 52 and 53 respectively arranged in axial alignment and maintained in juxtaposition by means of elongated clamping studs 54 which have their ends threadedly received in lugs 55 (FIG. 1) formed on the section 52 and which also pass through and serve to maintain a closure plate 56 similar to the plate 43 in position on the lower open rim of the composite block assembly. The block section 53 is connected to the side frame 10 by a flexible connection 57 which may be identical with the connection 47 previously described and which therefore needs no further description herein. The adjacent rim portions of the two block sections 52 and 53 are formed with thickened portions which, when the sections are assembled upon each other afford the previously described valve surfaces 27 and 28. These two surfaces are of frusto-conical configuration and are designed for selective hydraulic action with the similar but complementary surfaces 31 and 32 respectively (see also FIG. 4) formed on the piston or shoe 26.

The thrust rod or plunger assembly 22 includes the previously mentioned thrust rod proper 25 which is formed with a medial portion 62 of enlarged diameter and with upper and lower end portions 63 and 64 respectively of reduced diameter, affording shoulders 65 and 66 at the ends of the enlarged medial portion 62. The upper hydraulic equilizing piston 24 which operates in the cylinder block 40 is of cylindrical configuration and is maintained fixed on the thrust rod 25 by means of a sleeve 67 which serves to clamp the piston 24 against the the shoulder 65. A clamping nut and washer assembly 68 on the upper end of the rod 25 serves to effect the clamping action. The valve piston 26 is similarly maintained on the rod 25 within the cylinder assembly 21 by means of a sleeve 70 and a clamping nut and washer assembly 71 on the lower end of the rod 25, the sleeve 70 serving to force the valve piston 26 against the shoulder 66.

The reduced portion 64 of the thrust rod 25, as well as the surrounding sleeve 70 projects downwardly and outwardly through the closure plate 56 through which they are slidable and in which they are sealed by a gland 72 similar to the gland 45. A dust cap 73 shields the gland 72 against the entrance of dirt and the like. In the medial regions of the stabilizer assembly a corrugated flexible sleeve 75 surrounds the enlarged medial portion 62 of the thrust rod 25 and bears at its end against the opposed outer end surfaces of the upper and lower cylinder assemblies 20 and 21 to thus shield this portion of the rod against accumulation of dirt which, otherwise, would be subject to entrance into the cylinder assemblies at the regions of entrance of the rod 25.

The biasing spring 34 surrounds the enlarged portion 62 of the rod 25 and bears at its upper end against the upper end wall of the cylinder block section 52 and at its lower end against the valve piston 26. The biasing spring 33 surrounds the reduced portion 64 of the rod 25 and bears at its lower end against the closure plate 56 and at its upper end against the valve piston 26. The compression of the two springs 33 and 34 is matched so that the valve piston 26 "floats" so to speak within the medial region of the cylinder assembly 21 and so that the surfaces 31 and 32 (FIG. 4) remain in close proximity to but out of actual contact with their cooperating valve surfaces 27 and 28 on the inner faces of the cylinder block sections 53 and 52 respectively. As previously described, the biasing action of the two biasing springs 33 and 34 is controlling insofar as the positioning of the valve piston 26 is concerned inasmuch as any pressure which may be built up within the cylinder assembly 20 in the body of liquid 23 therein on either side of the piston 24 due to loading or unloading of the railway car and consequent displacement of the bolster 12 with respect to the car truck frame 10 will become equalized on opposite sides of the piston 24 through gradual passage of the liquid through the openings 35. Regardless of the applied load therefore, the biasing springs 33 and 34 will ultimately bring the valve piston 26 to its inoperative or neutral position out of contact with the bearing surfaces 27 and 28 although the distance between the upper and lower cylinder assemblies 20 and 21 will become decreased or increased as the load is increased or decreased respectively.

While the railway car is traveling over a roadbed, abnormal or sudden shocks which are applied to the car truck or frame 10 due to unevenness of the rails on the roadbed for example or for any reason whatsoever while the car is in motion will be transmitted to the snubbing cylinder assembly 21, thus displacing the cylinder proper vertically in one direction or the other. If, for example, a rise caused by an undulation in one of the track rails is encountered, the car truck frame, together with the cylinder 21 will be displaced upwardly, thus compressing the load springs and also placing the liquid 23*a* in the lower portions of the lower cylinder 21 under pressure. The pressure thus developed in the liquid in the cylinder 21 below the valve piston 26 will tend to cause the liquid to be bled to the opposite or upper side of the cylinder 21 while at the same time the resistance offered by the piston to the incompressible column of liquid during the bleeding action constituting a major portion of the snubbing or reaction force to the displacement between the bolster and car truck frame. Since, except for the provision of the centering springs 33 and 34, the piston and piston rod assembly 24, 25, 26 is a free floating member, the reaction offered by the piston 26 as previously described, will cause a gradual shifting movement of the piston rod 25 upwardly, the upper portion of the liquid 23 in the upper cylinder 20 will be placed under pressure so that the piston 24, like the piston 26, will offer a certain amount of reaction force to the relative displacement between the bolster and car truck frame. The function of the piston 24 however is an equalizing one as previously described and the major portion of the snubbing action is borne by the lower piston 26. The frusto-conical shape of valve piston 26 with its cooperating surfaces 31, 32 is such that movement of the cylinder 21 relative to valve piston 26 increases the resistance to flow of liquid 23*a* thereby increasing the snubbing force. This snubbing effect is increased in proportion to the amplitude of the forcing movement of the cylinder 21.

In a similar manner, downward movements of the car truck frame relative to the bolster will cause the liquid in the upper and lower portions respectively of the cylinder assemblies 20 and 21 to be placed under pressure with the pistons 24 and 26 offering the desired reaction force as the liquid is slowly bled upwardly through or around the pistons as the case may be.

In compliance with Title 35, U.S. Code, section 22, a preferred embodiment of the invention has been shown in the drawings and described herein, but it should be understood that the invention is not to be limited to the specific disclosure made and that the appended claims should be construed as broadly as the prior art will permit.

I claim:

1. A stabilizing mechanism for damping oscillations of a spring supported body constituting one of a pair of

bodies movable relative to each other from different normal positions, said mechanism comprising an hydraulic equalizing cylinder for attachment to and movable with said spring supported body, a snubbing cylinder for attachment to and having positive movement with the other body, an axially movable thrust rod common to and extending through both cylinders, an equalizing piston secured to said rod within the equalizing cylinder, a combined snubbing piston and valve secured to said rod within the snubbing cylinder, separate bodies of fluid media sealed in the separate cylinders and substantially filling them, means establishing a restricted by-pass for fluid across said equalizing piston, a pair of longitudinally spaced apart valve seats fixed to the inner wall of the snubbing cylinder in equally spaced relation to the combined snubbing piston and valve when the latter is in its neutral position, the said seats serving as stops for abruptly limiting the movements of the combined snubbing piston and valve from its neutral position and also cooperating therewith to define an annular passageway for fluid around the combined snubbing piston and valve, which passageway is progressively restricted by the movement of the said combined piston and valve from its neutral position, whereby the several parts of the mechanism cooperate during relative movements of said cylinders toward and away from each other from assumed normal positions to create increased pressure differentials at opposite sides of said equalizing piston and at opposite sides of said combined snubbing piston and valve and whereby continued movement of said equalizing cylinder and the body to which it is attached is damped by said pressure differential in said equalizing cylinder, and spring means abutting against at least one of said cylinders and effectively engaged with said rod to exert spring force thereon to adjust said combined snubbing piston and valve to its neutral position upon cessation of relative movement of said cylinders.

2. A stabilizing mechanism as set forth in claim 1 characterized in that said longitudinally spaced apart valve seats have frusto-conical surfaces and the perimeter of the combined piston and valve associated therewith is formed with frusto-conical surfaces opposed to the frusto-conical surfaces of said seats and cooperate therewith to define said annular passageway.

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TELESCOPING HYDRAULIC SHOCK ABSORBER

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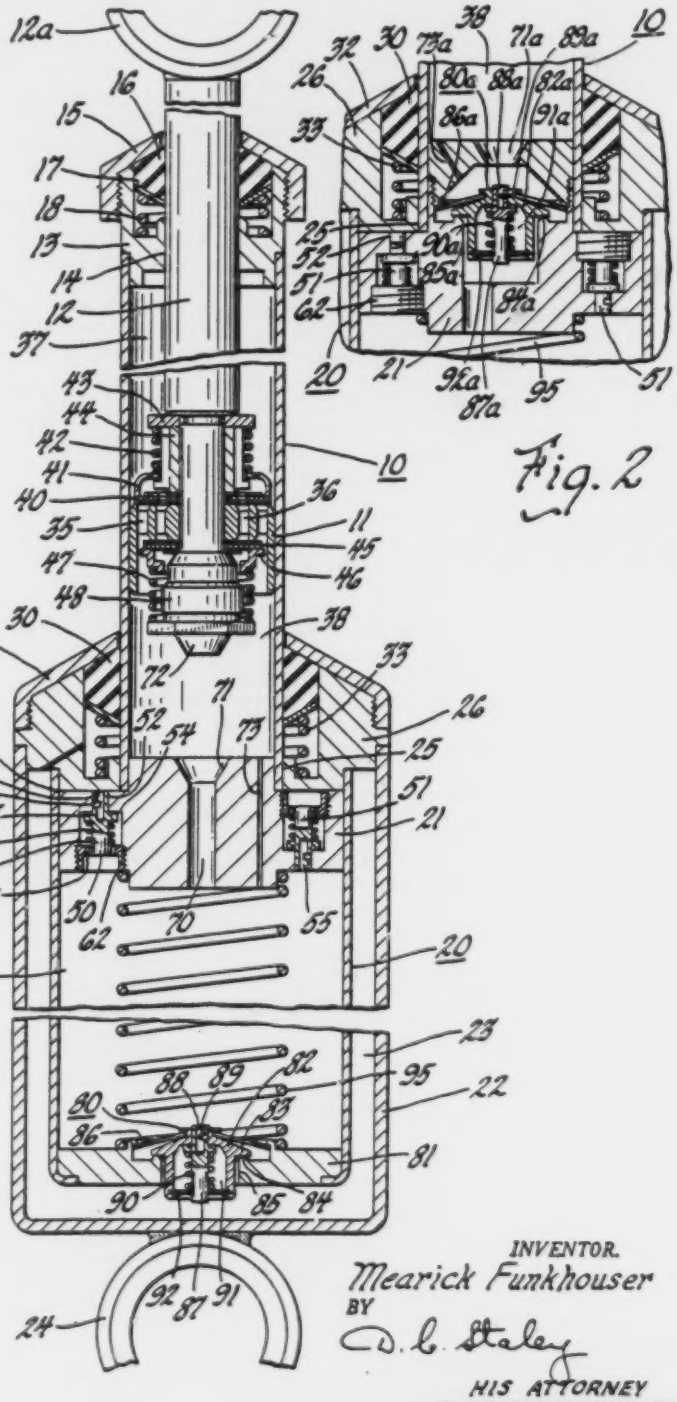

Fig. 1

Fig. 2

INVENTOR.
Mearick Funkhouser
BY
D. L. Staley
HIS ATTORNEY

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TELESCOPING HYDRAULIC SHOCK ABSORBER

Mearick Funkhouser, Dayton, Ohio, assignor to General Motors Corporation, Detroit, Mich., a corporation of Delaware

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6 Claims. (Cl. 267—8)

This invention relates to shock absorbers adapted for connection between the sprung mass or chassis of a vehicle and the unsprung mass or wheel system of the vehicle. More particularly, the invention relates to a direct-acting type shock absorber.

With the trend in motor vehicles being toward lower silhouettes, the clearance provided between the sprung mass or chassis of the vehicle and the unsprung mass or wheel system of the vehicle is being reduced, and while the wheel movement relative to the chassis is also reduced, it is not necessarily in the same amount. This results in less space being available for shock absorber installation.

The space required for shock absorber installation, as far as length is concerned, is the sum of the active and inactive portions of the shock absorber. The active part is that required by the relative movement of the sprung and unsprung masses and is usually referred to as the stroke of the shock absorber, while the inactive part is the difference in length between the stroke and the overall length of the shock absorber which must be included between the appropriate mounting parts of the sprung and unsprung members and is known as the dead length of the shock absorber. When the sprung and unsprung members are in their closest relationship, there must be sufficient clearance provided between these mounting parts to contain the sum of the active and inactive lengths of the shock absorber. In other words, the sum of the active and inactive lengths of the shock absorber must be sufficiently short as to fit within the clearance allowed between the sprung and unsprung members.

It is, therefore, an object of this invention to provide a direct-acting type shock absorber that is capable of providing a larger ratio between the active and inactive parts of the shock absorber. To obtain this result, it is an object of the invention to use a telescoping shock absorber having dual-acting cylinders and pistons of different diameters constructed and arranged in a manner that the small diameter piston and cylinder operate independently of the larger diameter piston and cylinder for a predetermined part of the full stroke of the shock absorber, the two pistons working concurrently during a part of the stroke so that a larger stroke to dead length ratio is obtained than is possible with a conventional shock absorber.

It is another object of the invention to provide a direct-acting type shock absorber that will accomplish the results of the foregoing objects wherein the small diameter piston of the shock absorber engages the large diameter piston at a predetermined point in the stroke of the unit, the pistons being constructed and arranged in a manner to provide for a hydraulic cushion between the pistons during the period of time the pistons are being brought into engagement, thereby lessening the magnitude of the accelerations due to physical engagement of the pistons.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein preferred embodiments of the present invention are clearly shown.

In the drawings:

FIGURE 1 is a vertical cross-sectional view of a shock absorber incorporating features of this invention.

FIGURE 2 is a vertical cross-sectional view of a portion of the shock absorber of FIGURE 1 but illustrating a modified arrangement.

The shock absorber illustrated in the drawings is a direct-acting type shock absorber and consists of a first cylinder 10 and a second cylinder 20. The shock absorber also includes a first piston 11 and a second piston 21, the pistons 11 and 21 being reciprocable in the respective cylinders 10 and 20.

The cylinder 10 carries the piston 21 on the lower end thereof so that the cylinder and piston move as a unit when the piston 21 reciprocates in the cylinder 20. Thus, the cylinder 10 functions as a rod member supporting the piston 21. The piston 11 in the cylinder 10 is carried on the lower end of the rod member 12 that projects exteriorly of the cylinder and has a fitting 12*a* on the upper end thereof that is adapted to connect with a suitable fitting, not shown, on the chassis of a vehicle.

The shock absorber cylinder 20 is encircled by a cylindrical container 22 that is in spaced relationship relative to the cylinder 20 thereby forming a reservoir chamber 23 for hydraulic fluid between the cylinder 20 and the chamber 22. The lower end of the chamber 22 carries a fitting 24 that is adapted for connection to a fitting, not shown, on the running gear of the vehicle. Thus the shock absorber will be retained between the sprung mass or chassis of the vehicle and the unsprung mass or running gear by the fittings 12*a* and 24.

The shock absorber cylinder 10 has the upper end thereof closed by a wall member 13 having a bore 14 through which the rod 12 extends to guide the rod in its reciprocable movement in the cylinder. A closure cap 15 is positioned on the closure wall 13 and retains a seal member 16 of elastomeric material between the closure cap and a pressure member 17 retained against the seal member 16 by the compression spring 18.

The lower end of the cylinder 10 is fixedly secured to the piston 21 and passes through a bore 25 in a closure member 26 that closes the end of the cylinder 20 and is engaged by the chamber wall 22 so as to form the closure member for the reservoir chamber 23. Thus, the closure member 26, in effect, forms the guide for the cylinder 10 in its reciprocable movement in the cylinder 20. A seal member 30 of elastomeric material is carried in the closure member 26 and is retained in the seal chamber 31 by a closure cap 32. A compression spring 33 retains the seal member 30 under pressure to effect engagement with the wall of the cylinder 10.

The piston 11 of the small diameter cylinder 10 has a series of openings 35 positioned adjacent the circumference of the piston. A second series of openings 36 are positioned within the radial circle of the openings 35. The openings 35 and 36 provide for flow of hydraulic fluid between the chambers 37 and 38 on opposite sides of the piston 11.

The openings 35 are normally closed by an annular disk valve structure 40 held in engagement with the seats around the openings 35 by means of a valve retainer 41 and a compression spring 42 that is placed between the valve retainer and the washer 43 positioned at the upper end of the spacer member 44 disposed between the washer 43 and the disk valve assembly 40 to hold the disk valve assembly on the upper side of the piston 11.

A disk valve assembly 45 closes the series of openings 36, a valve retainer 46 holding the disk valve assembly 45 on the seats around the openings 36. A spring 47 urges the retainer 46 against the disk valve 45. The spring 47 is held on the lower end of the rod 12 by means of a nut 48 which nut also holds the entire piston and valve assembly on the lower end of the rod 12.

The piston member 21 that is carried on the lower end

of the cylinder 10 is provided with one or more valve members 50 which control displacement of hydraulic fluid from the upper side of the piston 21 from the chamber space 60 into chamber space 61. Similarly, one or more valves 55 control displacement of the hydraulic fluid from the chamber space 61 to the chamber 60 above the piston 21. It will be noted that the valves 50 and 55 are of identical construction but are merely reversed in their direction of operation so as to control flow of hydraulic fluid between the chambers 60 and 61 in opposite directions. Valves 50 and 55 could be replaced by spring loaded disk valves similar to 40 and 45.

Each of the valves 50 and 55 consist of a valve member 51 that slides in a bore 52, an enlarged head 53 seating on a wall seat 54. The valve 51 is retained on the seat 54 by means of the compression spring 56. The valve member 51 has an axial bore 57 connecting with a radial bore or slot 58 so that when the valve 50, for example, is moved downwardly the slot 58 will move above the seal wall 54 and allow hydraulic fluid to pass through the passage 57, slot 58 and thence into the valve chamber 59 and through the openings 62*a* in the member 62 for flow of hydraulic fluid from the chamber space 60 into the chamber space 61.

Since valve member 55 is constructed like valve member 50, it operates in the same manner but controls flow of hydraulic fluid from the chamber space 61 into the chamber space 60.

The piston 21 has a central passage 70 that provides fluid connection between the chamber space 38 in the small diameter cylinder 10 and the chamber space 61 in the large diameter cylinder 20. This passage 70 is of sufficient size that there is substantially no restriction to flow of hydraulic fluid between the chambers 61 and 38.

It may be desirable to place a two-way valve similar to the base valve 80 in this passage 70, as illustrated in FIG. 2, with valve 80*a*.

As is apparent from the drawing, the area of piston 11 is smaller than the area of piston 21. Therefore, to smooth out the transition of control from the volume of fluid displaced by piston 11 to the volume of fluid displaced by both pistons 11 and 21, a valve 80*a*, like valve 80, may preferably be placed in passage 70. That is, with piston 11 doing the work as controlled by the resistance of the base valves 80—87, much less control will be required than when both pistons 11 and 21 are moving together. A tailored balance of control between the valve 80*a* in passage 70 and the base valves 80—87 can readily be established when it is desirable to divide the control between the base valve 80 and the similar valve 80*a* in passage 70.

The upper end of the passage 70 is in the form of a truncated cone 71. A projection 72 is provided on the head of the nut 48 and is also in the form of a truncated cone that cooperates with the truncated cone-shaped recess 71 to fit therein when the piston 11 moves downwardly to drive the piston 21 downwardly. The hydraulic fluid between the surfaces of the cone-shaped parts 71 and 72 will provide a hydraulic cushion between these parts at the time the two surfaces are brought into engagement, thus cushioning the shock of engagement and reducing the impact of engagement.

A restriction passage 73 connects the chambers 61 and 38 so that there will be a pressure balance between these chambers at all times even though the piston 11 is in engagement with the piston 21 and is driving the same, the cone-shaped part 72 closing the passage 70 at this time.

The larger diameter cylinder 20 carries a base valve 80 in the bottom wall 81 thereof, this valve providing for restrictive control of flow of hydraulic fluid from the chamber 61 to the reservoir 23 and relatively free flow of hydraulic fluid in the reverse direction. The valve 80 consists of a valve member 82 provided with a radial flange portion 83 that engages a seat 84 around the opening 85 in the wall 81. The valve member 82 is retained on the seat 84 by means of a light finger spring 86.

The valve member 82 carries a plunger valve 87 slidably supported in the member 82. This plunger valve has a central port 88 that connects with a radial port 89, the valve being held in the position shown in the drawing by a compression spring 90. When hydraulic fluid in the chamber 61 is placed under pressure, the plunger valve 87 will be moved downwardly against the action of the spring 90 until the radial slot 89 connects with the chamber 91 for restrictive control of flow of hydraulic fluid from the chamber 61 through the passage 88 and radial passage 89 into the valve chamber 91, and thence through openings 92 in the washer 93 for admission into the reservoir 23.

When the load is static, the several parts of the shock absorber assume their respective positions as shown in the drawing, compression spring 95 retaining the piston 21 against the closure wall 26.

In operation, the shock absorber piston 11 reciprocates in the cylinder 10 independently of the piston 21 in the cylinder 20 for a portion of the full stroke of the shock absorber allowed by the total length of the cylinder 10. When the shock absorber and the spring supported load are static, the piston 11 is disposed substantially midway between opposite ends of the cylinder 10. Thus, for a portion of the stroke of the shock absorber the piston 10 can operate independently of the piston 21. The resistance to displacement of hydraulic fluid between the chambers 37 and 38 at opposite sides of the piston 11 is controlled by the disk valve assemblies 40 and 45, this resistance to flow of displaced fluid being whatever may be desirable under the particular conditions of operation of the shock absorber.

When the shock absorber is under a compression stroke, that is piston 11 is moving toward the base valve 80, fluid is placed under pressure in the chambers 38 and 61 with sufficient fluid being displaced from the chamber 38 to chamber 37 to compensate for the movement of the piston 11 toward the base valve 80. However, there will be excess fluid that cannot be displaced from the chamber 38 into the chamber 37 because of the entry of the rod 12 into the chamber 37. This excess fluid will be displaced from the chamber 38 through the passage 70 into the chamber 61 and thence through the resistance valve 87 into the reservoir 23. When valve 80*a* is also used, as shown in FIG. 2, the displaced fluid works against the resistance valve 87*a* first and then against resistance valve 87. This valve 87 is modified by the action of valve 87*a*.

When the stroke of the shock absorber exceeds the distance provided between the piston 11 and the piston 21, the end portion 72 of the piston 11 will enter the recess 71 in the piston 21 to effect driving engagement of the piston 11 with the piston 21. During the interval of movement of the projection 72 into engagement with the surface of the recess 71, the film of hydraulic fluid between the respective surfaces will provide a fluid cushion or hydraulic cushion between the surfaces to soften the physical engagement of the projection 72 with the surface 71.

When the projection 72 on the pistons 11 engages the recess 71 in the piston 21, piston 21 will then be moved downwardly in the cylinder 20 to effect displacement of hydraulic fluid from the chamber 61 into the chamber 60 under control of the resistance valving 55. At this time no fluid will be displaced from the chamber 38 into the chamber 37 since relative movement between the piston 11 and the cylinder 10 has now come to a standstill. All additional stroke movement of the shock absorber will occur by movement of the piston 21 toward the base valve 80, piston 11, of course, moving toward the base valve concurrently with the piston 21 since the rod 12 is driving both pistons downwardly.

Since the piston 21 is of larger diameter than piston

11, the displacement of hydraulic fluid for a given movement between the sprung and unsprung masses will be greater than during movement of piston 11 in cylinder 10. At this time cylinder 10 functions as the rod for the piston 20 so that there is a volumetric differential of fluid that will be forced through the resistance valve 87 since downward movement of piston 21 displaces more fluid than can be received in chamber 60.

On the rebound stroke of the shock absorber, that is when pistons 21 and 11 move away from the base valve 80, fluid will be displaced from the chamber 60 through the resistance valve 50 into chamber 61, compression spring 95 urging the piston 21 upwardly to follow upward movement of the rod 12 that carries piston 11 and cylinder 10. When piston 21 reaches the position shown in the drawing, piston 11 will then move upwardly in the cylinder 10 independent of any connection with piston 21. All fluid required to refill the chambers 60 and 38 will be obtained from the reservoir 23 through the valve member 83 being lifted from its seat against the light finger spring 86, this return flow being relatively free, and in the case of FIG. 2, through valve member 83*a*. It will be understood, of course, that valves 53 and 45 will be effective to control relative movements between pistons 11 and 21 on this return stroke. A hydraulic cushion similar to that provided by the projection 72 and recess 71 can be provided between the head of piston 11 and the end closure wall 13.

From the foregoing description it will be apparent that the total length of a shock absorber providing the same stroke can be considerably less than if a uniform diameter cylinder is used since a part of the stroke of the shock absorber is effected under control of the large diameter piston 21. The portion of the full stroke of the shock absorber taken by the respective pistons 10 and 11 can be varied to meet requirements and the ratio of the diameters of the pistons 11 and 21 can be varied to control the maximum stroke of the shock absorber.

While the embodiments of the present invention as herein disclosed constitute a preferred form, it is to be understod that other forms might be adopted.

What is claimed is as follows:

1. A telescoping hydraulic shock absorber, comprising, first and second cylinders the first of which is reciprocable within the second, first and second pistons reciprocable in the second and first cylinders respectively, the first of which pistons is attached to said first cylinder for reciprocal movement therewith in said second cylinder and the second of which pistons is reciprocable in said first cylinder by rod means extending from the said first cylinder, said second piston being reciprocable independently of said first piston and engageable with said first piston to effect movement thereof therewith in the second of said cylinders, said cylinders having hydraulic connection between compression chamber portions thereof at comparable sides of the respective pistons for the cylinders, each of said pistons having valve means controlling flow of hydraulic fluid between opposite sides of the said pistons on compression and rebound stroke thereof as displaced by movement of the respective pistons, and closure means at one end of said second cylinder including valve means therein between the same and a hydraulic fluid reservoir means providing for controlled flow of hydraulic fluid to said reservoir means from either of the compression chambers of said cylinders as displaced on compression stroke by movement of either of said pistons and substantially free return of fluid from said reservoir to either of the said compression chambers on rebound stroke.

2. A telescoping hydraulic shock absorber, comprising, first and second cylinders the first of which is reciprocable within the second, first and second pistons reciprocable in the second and first cylinders respectively, the first of which pistons is attached to said first cylinder for movement therewith and the second of which pistons is reciprocable in said first cylinder by rod means extending from the said first cylinder, said second piston being reciprocable independently of said first piston and engageable with said first piston to effect movement thereof therewith in the second of said cylinders, said cylinders having free hydraulic connection between compression chamber portions thereof at comparable sides of the respective pistons for the cylinders through said first piston when said pistons are spaced from each other, valve means for each of said pistons controlling flow of hydraulic fluid between opposite sides of the respective pistons on compression and rebound stroke thereof as displaced by movement of the respective pistons, and closure means at one end of said second cylinder including valve means therein between the same and a hydraulic fluid reservoir means providing for controlled flow of hydraulic fluid to said reservoir means from either of the compression chambers of said cylinders as displaced on compression stroke by movement of either of said pistons and providing for relatively free return flow of hydraulic fluid from the reservoir means to either of said compression chambers of said cylinders on rebound stroke of said pistons.

3. A telescoping hydraulic shock absorber, comprising, first and second cylinders the first of which is reciprocable within the second, first and second pistons reciprocable in the second and first cylinders respectively, the first of which pistons is attached to said first cylinder for movement therewith and the second of which pistons is reciprocable in said first cylinder by rod means extending from the said first cylinder, said second piston being reciprocable independently of said first piston and engageable with said first piston to effect movement thereof therewith in the second of said cylinders, said cylinders having free hydraulic connection between compression chamber portions thereof at comparable sides of the respective pistons for the cylinders through said first piston until said second piston engages said first piston and closes said connection, valve means for each of said pistons for controlling flow of hydraulic fluid between opposite sides of the said pistons on compression and rebound stroke as displaced by movement of the respective pistons, and closure means at one end of said second cylinder including valve means for said second cylinder between the same and a reservoir means providing for controlled flow of hydraulic fluid to said reservoir means from either of the compression chambers of said cylinder as displaced on compression stroke by movement of either of said pistons and providing for relatively free return flow of hydraulic fluid from the reservoir means to either of said compression chambers of said cylinders on rebound stroke of said pistons, and additional passage means through said first piston providing hydraulic fluid connection between said compression chambers of said cylinders at all times to maintain thereby hydraulic pressure balance in the said cylinders during movement of the said pistons together.

4. A telescoping hydraulic shock absorber, comprising, first and second cylinders the first of which is reciprocable within the second, first and second pistons reciprocable in the second and first cylinders respectively, the first of which pistons is attached to said first cylinder for movement therewith and the second of which pistons is reciprocable in said first cylinder by rod means extending from the said first cylinder, said second piston being reciprocable independently of said first piston and engageable with said first piston to effect movement thereof in the second of said cylinders, each of said pistons having valve means therein respectively controlling flow of hydraulic fluid between opposite sides of the said pistons on compression and rebound stroke thereof as displaced by movement of the respective pistons, additional independently acting valve means in said first piston controlling flow of hydraulic fluid from the compression chamber of said first cylinder into the compression chamber of said second cylinder on displacement of fluid from said first cylinder by said second piston into said second cylinder and providing for relatively free return flow of

hydraulic fluid from the compression chamber of said second cylinder into said first cylinder on rebound stroke of said second piston in said first cylinder, and additional valve means in said second cylinder providing controlled flow of hydraulic fluid from the compression chamber of either of said cylinders to reservoir means as displaced by movement of either or both of said pistons and providing relatively free return flow of hydraulic fluid from the reservoir means to the compression chambers of both of said cylinders.

5. A telescoping hydraulic shock absorber constructed and arranged in accordance with claim 3 that includes resilient means in said second cylinder normally positioning said first piston at the end of said second cylinder remote from the valved closure end thereof with said second piston being positioned intermediate the ends of said first cylinder under static conditions.

6. A telescoping hydraulic shock absorber, comprising, first and second cylinders one of which is reciprocable within the other, first and second pistons reciprocable in the first and second cylinders respectively, one of which pistons is attached to said one cylinder for movement therewith and the other of which pistons is reciprocable in said one cylinder by rod means extending from the said one cylinder, the said one cylinder providing rod means for said one piston attached thereto, the said pistons and their cooperating rod means providing for differential displacement of hydraulic fluid in their respective cylinders on reciprocation of the said pistons in their respective cylinders, valve means on each of said pistons controlling flow of hydraulic fluid between opposite sides of the said pistons as displaced by movement of the pistons in their respective cylinders, said cylinders having hydraulic connection between compression chamber portions thereof at comparable sides of the respective pistons for the cylinders positioned in said one piston and providing for free flow of hydraulic fluid between said compression chambers of said cylinders during reciprocation of said other piston independently of said one piston and which is closed when said one piston is engaged by said other piston for concurrent movement therewith, and means in said other cylinder providing for controlled flow of hydraulic fluid from both of said compression chambers of said cylinders to reservoir means on the shock absorber as displaced by movement of either of said pistons in their respective cylinders and providing for relatively free return flow of hydraulic fluid from the reservoir means to both of said compression chambers of said cylinders on movement of the respective pistons away from the said last-mentioned valve means.

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Aug. 18, 1964 J. H. CARTER 3,145,055

SPRING MOTOR OPERATED TILTING DUMP TRUCK

Filed Feb. 12, 1959

Fig 2

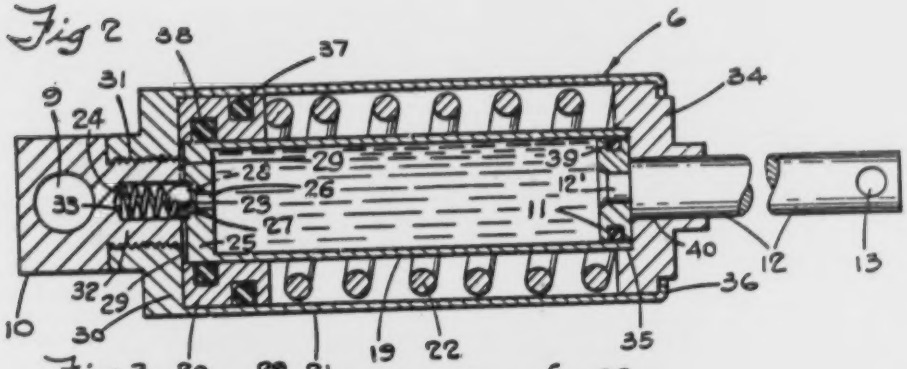


Fig 3

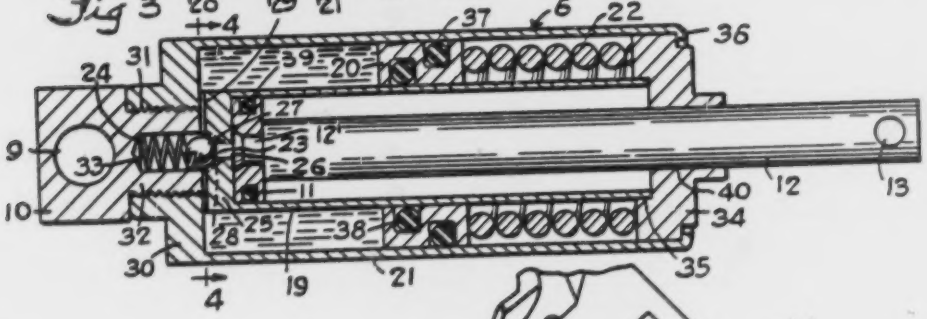


Fig 1

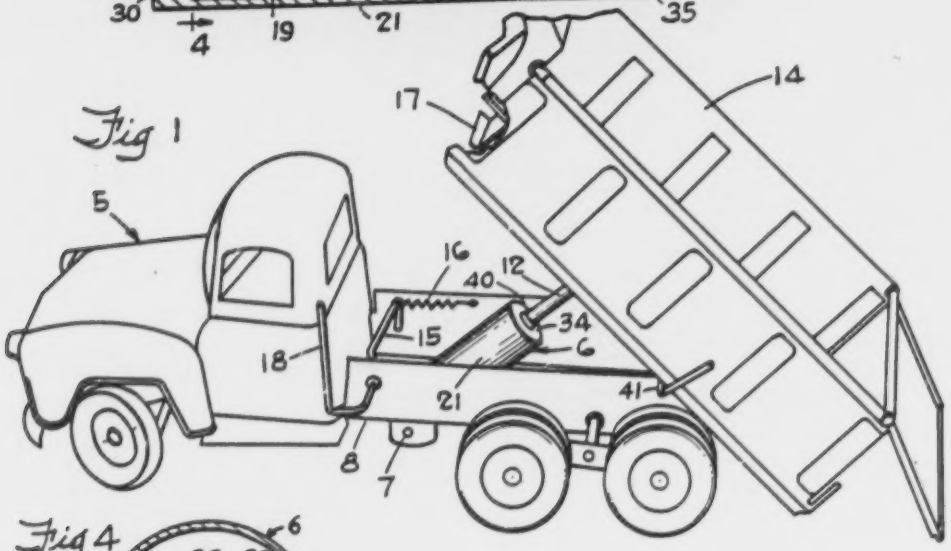
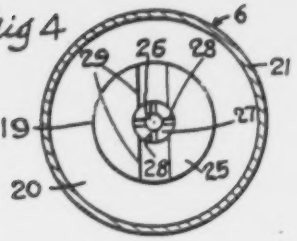


Fig 4



Inventor
Joseph H. Carter

Andrew F. Vinterson
Atty.

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SPRING MOTOR OPERATED TILTING DUMP TRUCK

Joseph H. Carter, 2517 E. State St., Rockford, Ill.

Filed Feb. 12, 1959, Ser. No. 792,734
10 Claims. (Cl. 298—22)

This invention relates to a dual hydraulic piston and cylinder mechanism, which, while herein disclosed as a spring motor applied to a toy dump-truck, for which application it was specially designed, is adapted for use also in door checks and closers, and the like, and wherever a relatively long stroke for the operated piston is required, while a relatively short and compact mechanism is essential or at least advantageous.

Toy dump-trucks with hydraulically operated pistons for operating the dump body became veritable "booby traps" when a certain amount of fluid leaked out of the cylinder, because when the body catch was released under such conditions the spring in the absence of the necessary fluid to slow down the working piston would operate it at high speed, so that a child could easily sustain a serious injury by contact with the dump body under those conditions. Injuries due to this defect in design and construction became so common that retailers, with good reason, refused to deal in hydraulic toys for a long time. It is, therefore, the principal object of my invention to provide an improved design and construction in which the piston is operable solely by fluid, and, in the event any of the fluid leaks out, the only noticeable effect is a reduction in the length of the stroke of the piston, and there is definitely no longer any possibility of injury to the operator.

The long piston stroke is obtained in accordance with my invention by having the working piston disposed in an inner cylinder of smaller diameter, while an outer concentric cylinder of larger diameter (and larger capacity per unit of length) contains the power spring and an annular piston operated thereby to deliver fluid from in front of the piston under pressure of the spring at a controlled rated to the inner cylinder to move the working piston, the moderate speed of the piston being positively assured by the seating of a spring-pressed check-valve, leaving only a small bleeder port open for passage of fluid into the inner cylinder from the outer cylinder. This check-valve unseats in the return movement of the working piston so that there is no interference with the speedy return of the dump body by hand to loading position.

The invention is illustrated in the accompanying drawing, in which—

FIG. 1 is a perspective view of a toy dump-truck equipped with a dual hydraulic piston and cylinder mechanism made in accordance with my invention for the safer operation of the dump body regardless of possible leakage of fluid from the piston and cylinder mechanism;

FIGS. 2 and 3 are longitudinal sections through the piston and cylinder mechanism showing the parts in the opposite extreme positions, FIGURE 3 being the one extreme prior to release of the dump body catch with the piston holding its rod fully retracted, and FIGURE 2 the other extreme at the end of the operation of the dump body with the piston holding its rod fully extended, and

FIG. 4 is a cross-section on the line 4—4 of FIG. 3.

The same numerals are applied to corresponding parts throughout the views.

Referring to the drawing, the toy dump-truck indicated generally by the reference numeral 5 in FIG. 1 is of the conventional design and construction similar to that disclosed in Wood Patent No. 1,602,424, but, in contrast to the undependable single piston and cylinder of that

patent, is shown equipped with a dual hydraulic piston and cylinder mechanism made in accordance with my invention and indicated generally by the reference numeral 6. A horizontal cross-pin 7 suitably supported on the frame 8 extends through a hole 9 in the plug 10 provided on one end of the mechanism 6 for pivotal connection of one end of the mechanism with the frame, and the working piston 11 of the mechanism 6, which is fixed on the reduced and upset inner end 12' of the rod 12 in the manner shown, has the outer end of its rod 12 pivotally connected at 13 with the bottom of the rearwardly tiltable dump body 14 intermediate the ends thereof to tilt the body rearwardly for dumping, as seen in FIG. 1. The frame 8 is referred to elsewhere as the fixed one of two "relatively movable parts" and the dump body 14 as the other or movable one of said "relatively movable parts." A U-shaped catch 15 pivotally mounted in the frame 8 has a tension spring 16 normally urging the same in a clockwise direction toward engagement with a lug 17 provided on the front end of the dump body 14, the catch being so arranged with respect to the lug that it will be swung forwardly out of the way as the dump body is swung downwardly by hand to its normal loading position, and will under tension of the spring 16 swing back into position over the lug 17 to lock the body in place automatically and hold it in that position until the release level 18 is swung forwardly by the operator to release the catch 15 and allow the dump body to be tilted by means of the working piston 11 under hydraulic pressure. The long stroke of the piston 11 substantially the full length of the mechanism 6 necessary for the tilting of the dump body 14 to the extent shown is made possible by the dual piston and cylinder construction shown in FIGS. 2–4, and with this construction I also obtain absolute safety of operation, as will soon appear, because the piston 11 is not operated directly by a spring, as in the prior constructions referred to above but depends for its operation upon the delivery of the oil or other working fluid to the inner cylinder 19 in response to movement of the annular piston 20 in the outer cylinder 21 under pressure of the power spring 22, the oil flow in this direction being regulated by a check-valve 23, so that the working piston 11 can move only as far as the available supply of oil or other working fluid will permit and cannot possibly move fast enough to give rise to any danger of injury to the operator, the oil flow being positively restricted by the seating of the check-valve 23 under the action of its associated spring 24.

Referring to FIGS. 2–4, to separate the inner ends of the two cylinders 19 and 21, the inner cylinder 19 is closed by a wall 25 at its inner end and an opening 26 is provided therein behind a tapered seat 27 for the ball check-valve 23. Bleeder ports 28 are defined by radial grooves in the seat 27 allowing restricted flow of oil under pressure of spring 22 past the check-valve 23 and into the front end of cylinder 19 when the check-valve 23 is seated. One or more larger radial grooves 29 are provided in the outer side of the end wall 25 to deliver oil to the adjacent end of the outer cylinder 21 in front of the annular piston 20 when the working piston 11 moves inwardly on its return stroke as the body 14 is lowered by hand, expelling oil from the inner cylinder past the unseated check-valve 23. The oil entering the outer cylinder under pressure forces the annular piston 20 to the rear, compressing the power spring 22 to load it for the next dumping operation. The front end wall 30 of the cylinder 21 forms an abutment for the front end 25 of the inner cylinder 19 and has a threaded center hole 31 in which the reduced threaded portion 32 of the plug 10 is threaded. An axial bore 33 in the inner end of the plug accommodates the coiled compression spring 24 that

holds the check-valve 23 normally seated. A plug 34, which has the rod 12 slidable freely in a center hole provided therein at 40 so that there is no noticeable air-cushion action in the operation of the piston 11, forms a closure for the open rear ends of both cylinders and has a central depression 35 in which the open end of the inner cylinder 19 is engaged and centered accurately relative to the outer cylinder 21, the rear end of the latter extending slightly beyond the plug and being swedged inwardly, as at 36, to complete the assembly and hold all of the assembled parts together. The oil or other liquid used can be put in cylinder 19 through opening 26 before check valve 23 and plug 10 are put in and while piston 11 is in fully retracted position, as in FIG. 2. Oil or other liquid can also be added through this same opening 26 in the extent of leakage.

O-rings 37 and 38 are entered in annular grooves provided in the outer and inner peripheries of the annular piston 20, respectively, to prevent oil leakage past the piston by contact with the inside of cylinder 21 and outside of cylinder 19. Another O-ring 39 is provided in an annular groove in piston 11 for a similar purpose.

In operation, with the dump body 14 swung down about its pivot 41 and latched at 15–17, the parts are disposed as seen in FIG. 3, power spring 22 being loaded as a result of the previous downward movement of the dump body 14 by hand. When the catch 15 is released, oil under pressure of spring 22 is delivered at a predetermined rate past check-valve 23 through the bleeder ports or grooves 28, moving piston 11 outwardly and swinging the body 14 upwardly slowly, similarly as occurs in large dump-trucks. There is no danger whatever of the piston 11 moving too fast and causing an injury to the operator. If any of the oil leaks out, the dump body 14 will not be tilted quite as far, but otherwise the operation is the same. In the resetting of the dump body, the piston 11 is moved inwardly fast, the oil in front thereof being expelled past the open check-valve 23 and forcing the piston 20 outwardly and loading the power spring 22.

In closing, it will be obvious that the dual hydraulic piston and cylinder mechanism 6 could be used also in a door check or door closer, and wherever a piston having a relatively long stroke and the other operating characteristics described is required or would be advantageous.

It is believed the foregoing description conveys a good understanding of the objects and advantages of my invention. The appended claims have been drawn to cover all legitimate modifications and adaptations.

I claim:

1. A dual piston and cylinder structure comprising two cylinders having inner and outer ends, the inner ends having a wall separating them with openings provided therein through which said cylinders have communication, check valve means housed in said wall cooperating with said openings to control fluid flow between said cylinders to provide a certain rate of flow in one direction between said cylinders with said check valve means seated and a different rate of flow in the opposite direction with said check valve means unseated, the outer ends of said cylinders having walls therein, a piston reciprocable in one of said cylinders having a rod connected therewith and extending through an opening provided in the outer end wall thereof, a piston reciprocable in the other of said cylinders, and a spring compressible between said last named piston and the outer end wall of said last named cylinder.

2. A structure as set forth in claim 1, including a fill opening for hydraulic fluid provided in said first mentioned wall communicating with the first of said cylinders from outside of said cylinders, and a closure for said opening.

3. A structure as set forth in claim 1, including a fill opening for hydraulic fluid provided in said first mentioned wall communicating with the first of said cylinders from outside of said cylinders, and a closure for said opening, said closure being removable and [illegible]ceable so as to permit replenishing hydraulic fluid in event of leakage.

4. A structure as set forth in claim 1, wherein said cylinders are concentrically arranged, the spring pressed piston being annular and disposed in the outer one of said cylinders and the spring being coiled and being disposed in the outer cylinder behind the piston and encircling the inner cylinder.

5. A structure as set forth in claim 1, including hydraulic fluid in said cylinders between said pistons, whereby movement of one piston is transmitted through the intervening fluid to or from the other piston.

6. A dual piston and cylinder structure comprising an inner cylinder and an outer cylinder surrounding the same in rigid relationship thereto, end wall means closing one end of said cylinders, a piston reciprocable in the inner cylinder having a rod connected therewith and extending through an opening provided therefor in said end wall means, a piston reciprocable in the outer cylinder and arranged to compress a spring disposed in said outer cylinder between said piston and said end wall means, a second end wall means closing the other end of said cylinders and having openings provided therein through which the last mentioned end of said cylinders have communication, check valve means cooperating with said openings to control fluid flow between said cylinders to provide a certain rate of flow in one direction between said cylinders with said check valve means seated and a different rate of flow in the opposite direction with said check valve means unseated, and an end closure secured to the last named end wall means serving as a housing for said check valve means and as a closure for that end of said cylinders.

7. A structure as set forth in claim 6, including hydraulic fluid in said cylinders between said pistons, whereby movement of one piston is transmitted through the intervening fluid to or from the other piston.

8. A structure as set forth in claim 7, wherein the last named end closure and check valve means are both removable to enable filling the inner cylinder with hydraulic fluid or replenishing such fluid in event of leakage.

9. A structure as set forth in claim 6, wherein the last named end wall means comprises a separate inner end wall on one end of the inner cylinder with a port provided therein, and a separate outer end wall on the corresponding end of the outer cylinder abutting the inner end wall, the end closure closing an opening provided in the outer end wall which communicates with the port provided in the inner end wall, the check valve means cooperating with the latter port in the inner end wall.

10. In combination, a dump vehicle comprising a frame, a body pivoted with respect to said frame for tilting to dumping position, latch means releasably locking said body in lowered position relative to said frame, and a spring motor for said vehicle pivotally connected on one hand with said frame and on the other hand with said body, said motor comprising an inner cylinder and an outer cylinder surrounding the same in rigid relationship thereto, end wall means closing one end of said cylinders, a piston reciprocable in the inner cylinder having a rod connected therewith and extending through an opening provided therefor in said end wall means for pivotal connection to one of said body and frame, a piston reciprocable in the outer cylinder and arranged to compress a spring disposed in said outer cylinder between said piston and said end wall means, a second end wall means closing the other end of said cylinders and having openings provided therein through which the last mentioned end of said cylinders have communication, check valve means cooperating with said openings to control fluid flow between said cylinders to provide a certain rate of flow in one direction between said cylinders with said check valve means seated and a different rate of flow in the opposite direction with said check valve means un-

seated, and an end enclosure secured to the last named end wall means serving as a housing for said check valve means and as a closure for that end of said cylinders, said end closure being pivotally connected to the other of said body and frame.

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RAILROAD CAR SHOCK ABSORBER

Filed Aug. 19, 1964 4 Sheets-Sheet 1

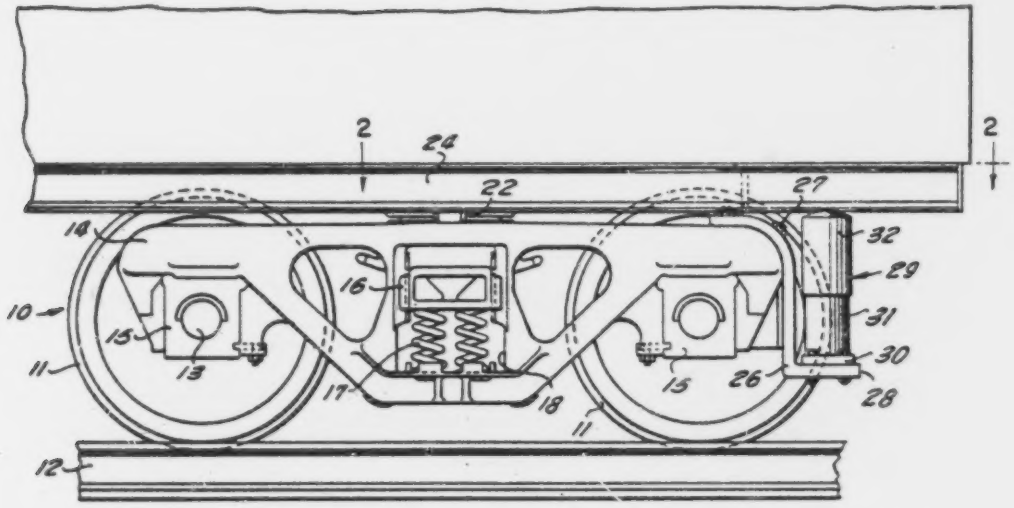

Fig. 1

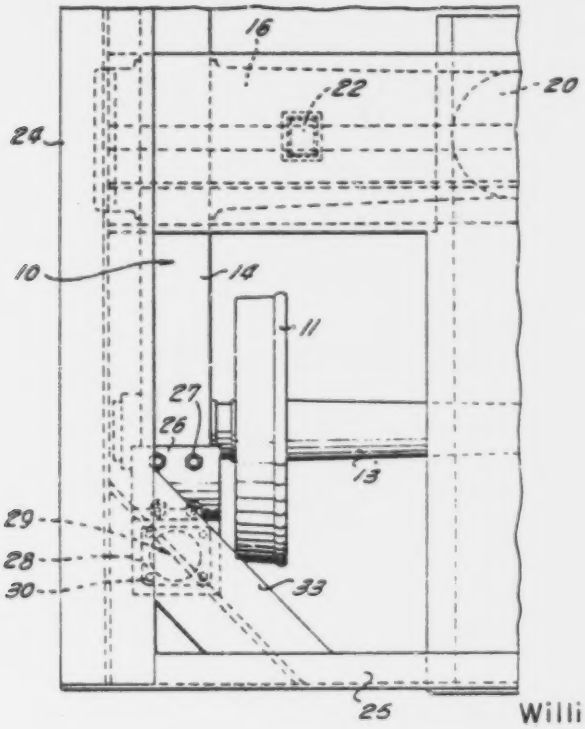

Fig. 2

INVENTOR
William T. Blake

BY John O. Evans, Jr.
ATTORNEY

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RAILROAD CAR SHOCK ABSORBER

Filed Aug. 19, 1964 4 Sheets-Sheet 2

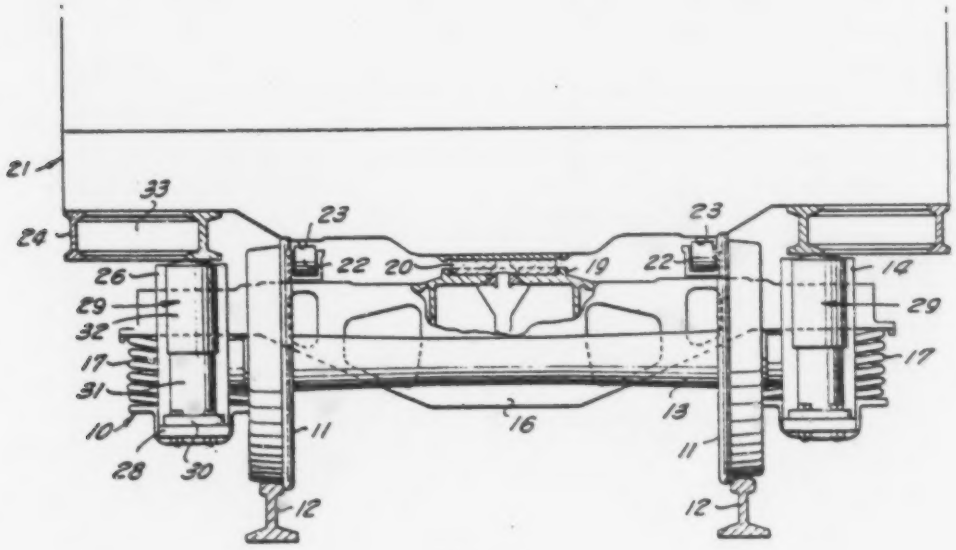

Fig. 3

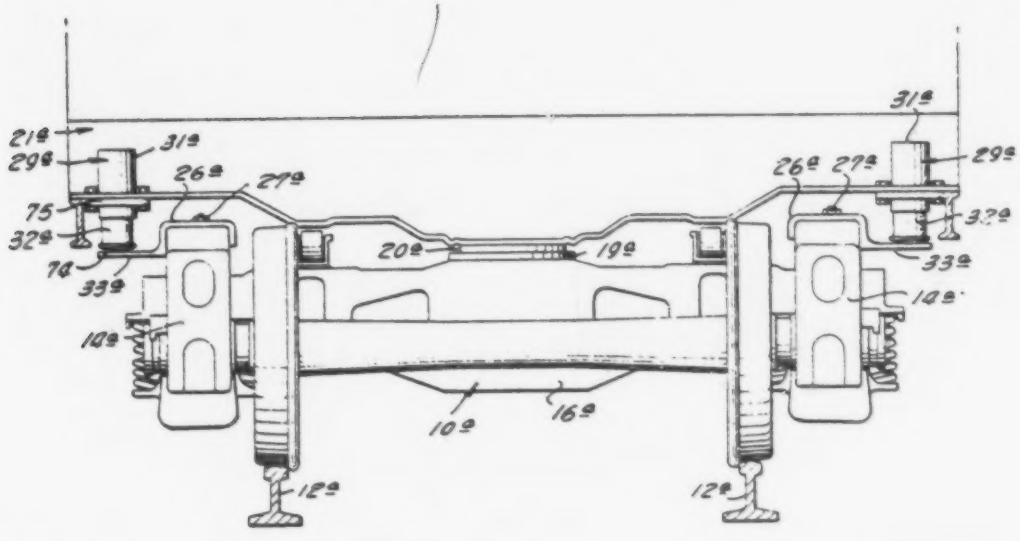

Fig. 4

INVENTOR
William T. Blake

BY John O. Evans, Jr.
ATTORNEY

Nov. 7, 1967 W. T. BLAKE 3,351,336

RAILROAD CAR SHOCK ABSORBER

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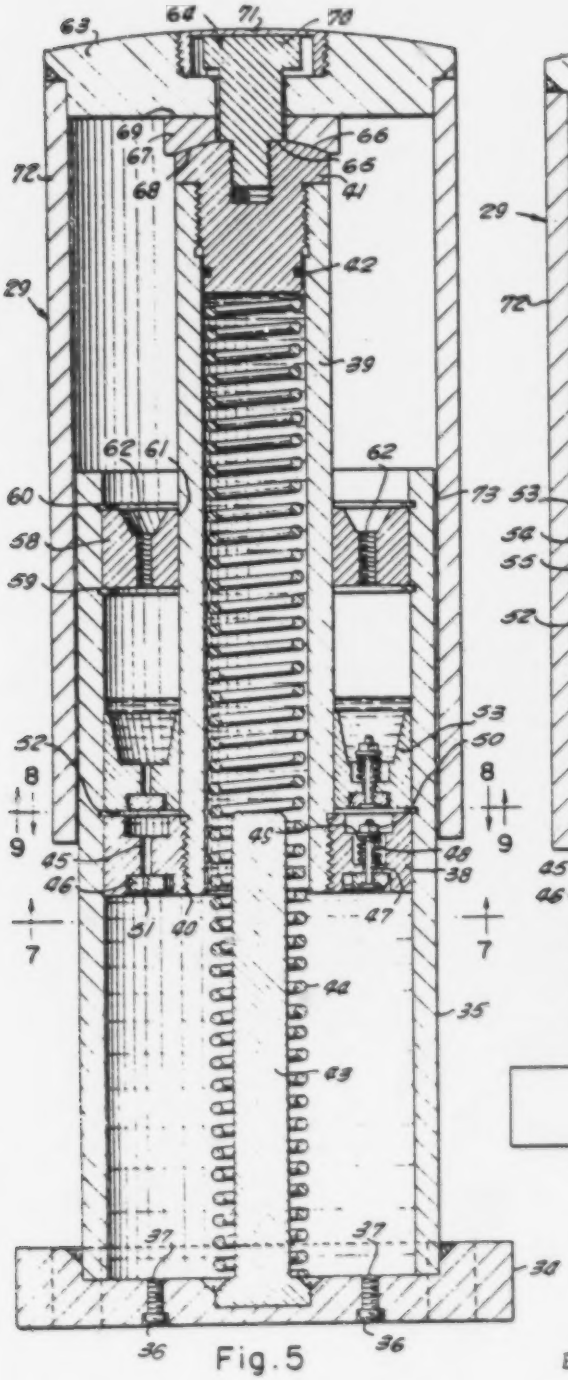

Fig. 5

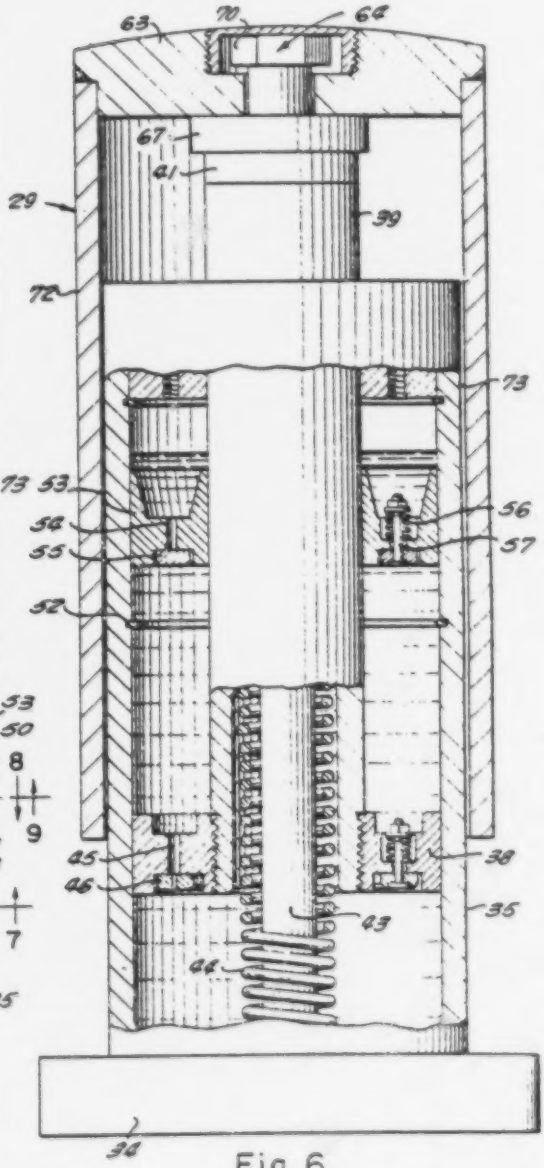

Fig. 6

INVENTOR
William T. Blake

BY John O. Evans, Jr.
ATTORNEY

Nov. 7, 1967 W. T. BLAKE 3,351,336

RAILROAD CAR SHOCK ABSORBER

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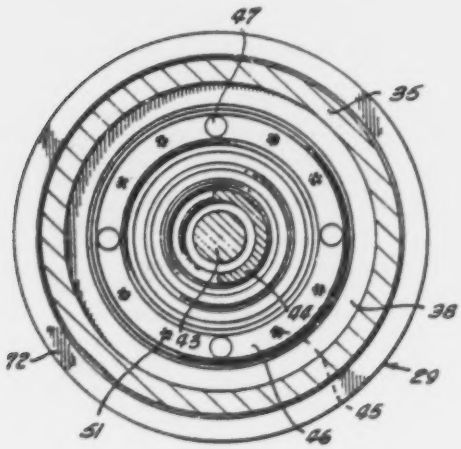

Fig. 7

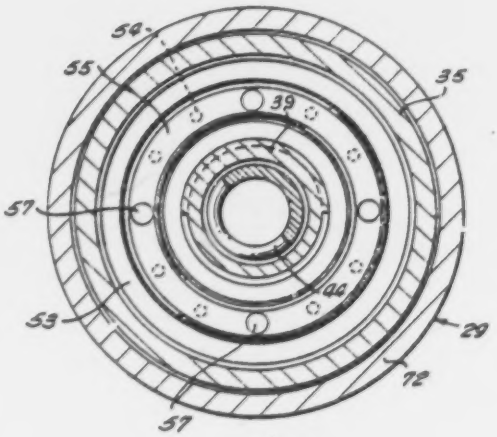

Fig. 9

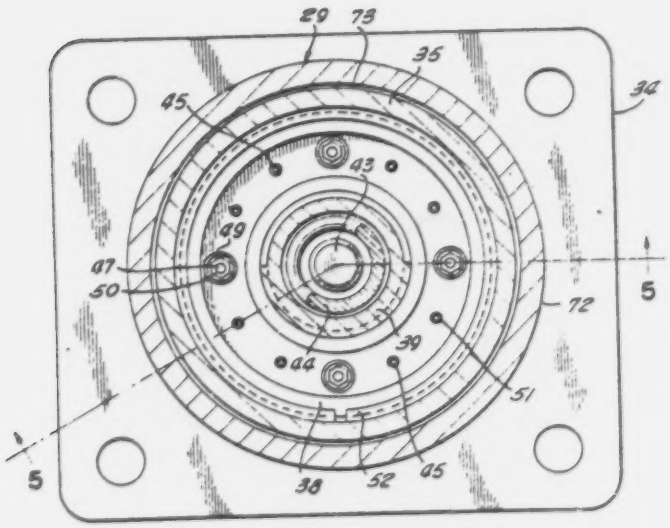

Fig. 8

INVENTOR
William T. Blake

BY John O. Evans, Jr.
ATTORNEY

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RAILROAD CAR SHOCK ABSORBER

William T. Blake, 4424 Morris Court,
Fort Worth, Tex. 76103

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5 Claims. (Cl. 267—3)

This invention relates to shock absorbers especially for railroad cars, and to railroad cars equipped with shock absorbers for controlling motions of the car body with respect to the trucks.

Railroad cars, such as freight cars, when running on a track are often damaged, but the car lading is damaged more frequently. Important causes of such damage are the rolling, bouncing, or pitching motions of the car bodies, or combinations of any two or all three of these motions. Roughness of the track, even though slight, may impart large swings to the car body. Thus, when a car hits waves in a track with a frequency corresponding to the natural frequency of motion of the car body on the trucks, the car body lurches violently. Sometimes this lurching extensively damages the lading and the car, and it can, if severe, derail the car.

The main object of the invention is to provide a railroad car, particularly a freight car, in which movements of the car body on the trucks are kept within acceptable limits.

Another object is to provide a railroad car that rides smoothly over the rails, whereby the chances of damaging the car lading and the car itself are low.

Another object of the invention is to provide a railroad car that is cushioned against side sway and other body motions without interference with the turning of the trucks.

Another object is to enable existing railroad cars to be readily altered to provide a car in accordance with the invention.

Yet another object is to provide a side sway cushioning arrangement that is easily installed in the building of a railroad car.

Still another object of the invention is to provide a railroad car having a side sway cushioning system that is reliable and simple to maintain, and that has a long service life.

Another object of the invention is to provide a hydraulic shock absorber that is especially adapted for use in controlling railroad car body movements.

Another object is to provide a hydraulic shock absorber in which the hydraulic liquid is prevented from foaming.

Still another object is to provide a hydraulic shock absorber that operates without forming an internal vacuum.

Certain of the foregoing and such other objects of the invention as appear hereinafter are attained in a railroad car having a car body structure; and a truck having wheels, an unsprung frame structure, and means supporting the car body structure for pivotal movement on the truck about a substantially vertical axis, the supporting means including resilient means permitting rolling, pitching and bouncing of the car body structure on the unsprung frame structure. A pair of shock absorbers or car stabilizers is provided, each stabilizer having a pair of relatively movable members, a body of liquid, and means metering the liquid to absorb energy as the members are moved. The car stabilizers are mounted at opposite sides of the pivotal axis of the car body structure to absorb energy of movement of the car body structure towards the unsprung frame structure. The mounting means for the stabilizers includes means fixing one of the movable members of each car stabilizer to one of the foregoing structures, and means permitting sliding movements of the other movable

members of the car stabilizers on the other of the structures as the car body structure pivots on the truck.

Other objects of the invention are realized in a hydraulic, shock absorbing mechanism including a cylinder; a cylinder head closing one end of the cylinder; a piston slidable in the cylinder; means providing for the flow of fluid from side to side of the piston as the piston is reciprocated in the cylinder; a piston shaft carried by the piston and extending away from the cylinder head; and an annular piston slidingly mounted on the shaft and slidable in the cylinder.

In the drawings:

FIG. 1 is a fragmentary side view of one end of a railroad boxcar embodying the invention;

FIG. 2 is a partial sectional view taken along the line 2—2 of FIG. 1;

FIG. 3 is a right end view of the car shown in FIG. 1, with parts broken away;

FIG. 4 is a view similar to FIG. 3 of a railroad car embodying another form of the invention;

FIG. 5 is an axial sectional view taken along the line 5—5 of FIG. 8 of a shock absorber or stabilizer embodying the invention, the view showing positions of the parts when the piston shaft is fully extended;

FIG. 6 is an axial sectional view also taken along the line 5—5 of FIG. 8 showing the position of the parts when the piston shaft is moved partly into the cylinder;

FIG. 7 is a sectional view taken on the line 7—7 of FIG. 5;

FIG. 8 is a sectional view taken on the line 8—8 of FIG. 5; and

FIG. 9 is a sectional view taken on the line 9—9 of FIG. 5.

Referring to FIGS. 1 to 3, the railroad boxcar shown is conventional, except for certain added components that are combined with the car, which added components will be identified hereinafter. As is typical of railroad freight cars, the illustrated car has a truck 10, including wheels 11, 11, 11, 11 that ride on track rails 12, 12. The wheels are sweated to parallel axles 13, 13 upon the outer ends of which the side frames 14, 14 are carried by journal boxes 15, 15, 15, 15. The wheels, axles, side frames, and journal boxes are unsprung components of the truck; that is, there are no resilient or cushioning devices between these parts and the track rails.

The truck further includes a transverse bolster 16. Springs 17, 17 are mounted on the side frames in openings 18, 18, and resiliently support the bolster at its ends. At the top center of the bolster is a pivot bearing having a low element 19 on the bolster and a complementary upper element 20 on the car body 21. The bolster also has a pair of rollers 22, 22 mounted on it outwardly from the pivot bearing. These rollers are adapted to engage flat surfaces 23, 23 on the car body to limit tilting of the car body on the bolster.

The body has the usual longitudinal frame members 24 and end frame members 25.

In accordance with the invention, the car heretofore described is modified by the addition of hydraulic shock absorbers. As thus modified, each side frame has a bracket 26 attached to its by bolts 27, 27. A platform 28 at the bottom of the bracket carries a single-acting, quick-return, hydraulic shock absorber 29. The shock absorber has a base 30 bolted to the platform, a fixed member 31, and a relatively movable member 32 that is vertically reciprocable on the fixed member. The top of the movable member bears against a horizontal flat surface on the bottom of the car body. This flat surface is provided in part by a wear beam 33, welded between a longitudinal frame member 24 and an end frame member 25 of the car body, and

in part by the flat bottom surfaces of the longitudinal and the end frame members themselves. This flat surface slides on the top of the shock absorber as the car body pivots on the truck.

Although the details of construction and of operation of the shock absorber will be fully described hereinafter, a brief statement here will help the reader understand how the car works. The movable member of the shock absorber is urged upwardly against the wear beams by an internal spring. When the movable member is pushed down, high resistance to movement is encountered and energy is absorbed in the shock absorber. And when the movable member is released, the internal spring quickly moves it up against low resistances.

While only one end of a boxcar is shown in the drawings, it will be understood that the other end of the boxcar is similar. It has a truck like the truck **10**, but this truck faces in the opposite direction so that the shock absorbers are located as close as possible to the near end of the car body.

Normal pivoting of the car body on the trucks is not affected by the absorbers. Moreover, the shock absorbers acts in their intended way whether the car is running on a straight or curved section of track, or whether it is going into or coming out of a curve. These desirable characteristics are present because the wear beams of the car slide with little effort over the tops of the shock absorbers, allowing the shock absorbers to adjust themselves to the various angular positions taken by the trucks

Referring to FIG. 4, showing a railroad car embodying another form of the invention, the car, apart from the shock absorber installation, is the same as the car in FIGS. 1 to 3. It has a truck **10***a* at either end, the trucks riding on rails **12***a*. The truck has side frames **14***a*, **14***a* and a pivot bearing **19***a*, **20***a* supporting a car body **21***a*.

Shock absorbers **29***a*, **29***a* are carried by the car body. Each shock absorber has an upper fixed member **31***a* having a base **30***a* which is bolted onto the car body. Each shock absorber also has a lower movable member **32***a* which slides in an arcuate path on the flat top surface of a wear plate **33***a* as the car body pivots on the trucks. This wear plate has an integral bracket **26***a* which is attached to the side frame **14***a* by bolts **27***a*, **27***a*. The shock absorbers **29***a*, **29***a* are in line with the bolster **16***a* when the truck is squared with the car, so that they bear down along a line extending across the truck at its center.

Shock absorbers **29***a*, **29***a* function similarly to their counterparts **29**, **29**. The movable members **32***a*, **32***a* are biased into contact with the wear plates by internal springs (not shown). When these movable members are forced upwardly into the fixed members **31***a*, they move against the resistance of hydraulic fluid flowing through metering orifices, whereby energy is absorbed and dissipated. And when the movable members are moved down by the internal springs, they move quickly and against low resistance to maintain their contact with the wear plates.

The shock absorbers **29***a* control the motions of the car **21***a* in about the same way as the shock absorbers **29** control the motions of the car **21**, all as described hereinbefore. It is thought unnecessary to repeat that description here, as the operation of the car of FIG. 4 will be obvious from the earlier description.

An embodiment of the invention as it relates to shock absorbers will now be described with reference to FIGS. 5 to 9. The illustrated shock absorber **29** has a rectangular base **34** to which is welded a cylinder **35**, the base forming a head for the bottom of the cylinder. Removable plugs **36**, **36** are screwed into tapped openings **37**, **37**, through which hydraulic fluid may be put into the cylinder.

A piston **38** is slidably fitted in the cylinder. The piston has a shaft **39** screwed into a threaded central opening **40** in the piston. The shaft is tubular, it being open at the bottom and closed at the top by a plug **41** threaded into the shaft. An O-ring **42** seals the plug into the shaft against leakage of fluid from within the shaft.

A guide pin **43** is welded to the center of the inside of the cylinder head and projects into the bore of the piston shaft with sufficient clearance to accommodate the piston return spring **44**. This spring is compressed between the piston shaft plug **41** and the cylinder head and urges the piston shaft and piston subassembly up.

The piston **38** has a number of ports **45** passing through it. These are normally closed by a ring check valve **46** having four valve stems **47** that pass through the piston. The ring valve is biased to closed position by valve springs **48** that press up on washers **49** secured to the valve stems by nuts **50**. Opposite each port **45**, the ring check valve has a small metering orifice **51**. However, fewer metering orifices may be used, and even one orifice may be enough, depending upon the resistance desired.

Upward movement of the piston is limited by a snap ring **52** in the cylinder wall.

Above the snap ring and slidable on the piston shaft and in the cylinder is an annular compensating piston **53**. Although this may be a piston without openings through it, as shown it has vertical openings **54** that are normally closed by a ring check valve **55**. This check valve a similar to the check valve **46** of the piston **38**, except that it has no metering orifices. The check valve **55** is resiliently urged to close the openings **54** by valve springs **56** that bias the valve stems **57** up.

The top of the cylinder has an annular closure member **58** held in position by snap rings **59** and **60**. The piston rod slides in a central opening **61** in the closure member which acts as a guide for the piston rod. Vents **62**, **62** extend through the closure member. These vents are tapped to receive temporary closure plugs, not shown, that are inserted prior to filling the shock absorber with hydraulic fluid. The plugs are left in place for shipment of the shock absorber and are removed when it is installed on a railroad car.

A bearing shoe **63** is fastened to the piston shaft closure plug **41** by a bolt **64**. The bolt has a shoulder **65** that is set against the spherical surface **66** of the top of the closure plug. A washer **67** is loosely fitted on the shank of the bolt. This washer has a spherical hollow **68** that mates with the spherical surface **66**, and a flat top surface **69** engaged by the flat bottom surface of the bearing shoe. Clearance is provided between the bolt head **70** and the shoe. A bolt head cover **71** is removably threaded into the bearing shoe to protect the bolt and to form a smooth bearing surface on the top of the shoe.

A cylindrical case **72** is welded to the bearing shoe and extends down around the outside of the cylinder **35**. The case is spaced from the cylinder to provide a working clearance **73** between these parts.

Operation of the shock absorber will now be explained with reference to FIGS. 5 and 6. FIG. 5 shows the shock absorber with the piston in the fully elevated position. In FIG. 6, the piston is shown in an intermediate position about half way between its top and bottom positions. With the parts disposed as shown in FIG. 5, the shock absorber is filled with hydraulic fluid such as oil to a level just above the top of the compensating piston **53**. The space between the compensating piston and the piston **38**, the openings in the pistons, and the spaces in the cylinder below the piston **38** and in the bore of the piston shaft are also filled with hydraulic fluid. The space in the cylinder above the surface of the hydraulic fluid is occupied by air.

When a downward force is applied to the shoe **63**, the piston shaft and piston **38** are forced into the cylinder. Hydraulic fluid flows from below the piston, through the metering orifices **51** in the check valve, and through the ports **45** to the zone above the piston. At the same time, the piston return spring is compressed. The metering of fluid through the orifices **51** causes substantial resistance to descent of the piston, and, smoothly dissipates most of the kinetic energy of the piston.

As the piston shaft moves down through the central opening in the compensating piston **53**, the shaft displaces

hydraulic fluid trapped between the piston and the compensating piston. The compensating piston rises in the cylinder by a distance directly related to the volume of hydraulic fluid so displaced. On the down stroke of the piston, the check valves in both the piston and the compensating piston are held closed by their respective valve springs and by the pressure of the fluid below the valves.

With the parts in the positions shown in FIG. 6, if downward pressure is released from the shoe 63, the return spring forces the piston shaft and piston up. The check valve 46 in the piston opens against the force of the valve springs 48, allowing liquid above the piston to flow freely down through the openings 45 as the piston rises. Concurrently, the compensating piston 53 falls in the cylinder, to fill the void created by withdrawal of the piston shaft through the central opening in the compensating piston.

There is no need for the check valve 55 in the compensating piston to open if the compensating piston descends freely in the cylinder. However, if the compensating piston should momentarily hang in the cylinder, or should work sluggishly, the check valve 55 would open to let hydraulic fluid from above the compensating piston flow down through the openings 54 and thereby prevent cavitation, or the drawing of a vacuum, in the fluid below the compensating piston.

There is another condition in which the check valve 55 in the compensating piston functions to prevent such cavitation. If the shock absorber remains for a long time with the piston in an intermediate position as in FIG. 6, the compensating piston may settle down in the cylinder until it comes to rest on the snap ring 52. Now, if the piston and piston shaft are suddenly depressed the compensating piston can not descend. But, the check valve 55 will open to allow fluid to flow from above the compensating piston into the space between the two pistons, thus preventing cavitation in this space. And, after a few strokes of the piston and shaft, the compensating piston will find its normal operating position.

It will be seen from the foregoing description of operation that the compensating piston prevents cavitation in the hydraulic fluid below it. It also acts as a floating or movable barrier between the main body of hydraulic fluid below the compensating piston and the air above, keeping air out of the main body of fluid and eliminating frothing. Of course, frothing in the main body of fluid would introduce compressible gas into the working fluid, and thus seriously interfere with the desired cushioning action of the shock absorber.

When four shock absorbers 29 are installed in a railroad car, as in FIGS. 1 to 3, they are subject not only to downward forces applied by the car body, but also to transverse thrust forces that are applied to the shoes 63 by the wear beams 33 as they slide over the shoes when the car body pivots on the trucks. These transverse thrust forces are adequately resisted by the shock-absorbers because of certain features of their construction. The main cylinder 35 is rigidly welded to the base 34 which, in turn is securely bolted to a truck side frame 14. The case 72 of the shock absorber overlaps the cylinder for a substantial distance and is free to move laterally with respect to the cylinder within the limits of the clearance 73 between these parts. This freedom of lateral movement is allowed by the loose fit of the shoe 63 on the shank of the bolt 64. Thus, lateral thrust forces are transmitted from the shoe through the case to the rigidly mounted cylinder, without being applied by the shoe to the bolt 64 and to the piston shaft. Any slight misalignment of the shoe with the piston shaft that may result is compensated for by the washer 67 with its loose fit on the shank of the bolt 64 and its contact with the piston shaft plug 41 through the spherical surfaces 66 and 67.

Moreover, the piston shaft and piston assembly is highly resistant to any minor transverse thrust forces that may be applied to the top of the shaft. The shaft is supported by three longitudinally spaced members namely: the piston 38, the compensating piston 53, and the annular cylinder closure member 58. These members prevent binding of the shaft and piston in the cylinder when thrust forces normally encountered in operation are applied to the piston shaft.

With reference to FIG. 4, the shock absorbers 29*a* may have the same internal construction as the shock absorbers 29 shown in FIGS. 5 to 9, and they may stand in the same direction, that is with the piston shaft extending up from the piston. In this arrangement, the fixed member 29*a* is the case, and the movable number 32*a* is the cylinder. A shoe 74 is supplied at the bottom of the cylinder and a mounting base 75 is fixed to the case.

Various modifications may be made in the specific embodiments of the invention shown and described herein without departing from the spirit of the invention as defined in the claims.

I claim:

1. A single-acting, hydraulic, shock absorbing mechanism comprising: a cylinder, a cylinder head closing one end of said cylinder, a piston slidable in said cylinder, port means extending longitudinally through said piston, check valve means for said port means, said check valve means opening toward said cylinder head, metering port means for allowing fluid to pass through said piston when said check valve means is closed, a hollow piston shaft carried by said piston and extending away from said cylinder head, an annular piston slidably mounted on said piston shaft and slidable in said cylinder, second port means extending longitudinally through the latter said annular piston, second check valve means for said second port means, said second check valve means opening toward said first-mentioned piston, and resilient means biasing said first-mentioned piston away form said cylinder head, said resilient means comprising a coil compression spring mounted within the hollow piston shaft, the spring having one end engaging an element on the piston shaft, the other end engaging said cylinder head.

2. The combination set forth in claim 1 together with piston shaft guide means supported in said cylinder and positioned remotely from said cylinder head.

3. The combination set forth in claim 1 including a spring guide pin carried by said cylinder head, said pin extending inside of said coil compression spring.

4. A single acting, hydraulic, shock absorber, comprising: a cylinder closed at its lower end and having a stop intermediate its ends, a vented guide at its upper end, a compensator piston freely movable in said cylinder between said guide and said stop, a shock absorbing piston movable in said cylinder between its lower end and said stop, a tubular stem protruding from the upper end of said cylinder and closed at its extended end, said stem being secured to said shock absorbing piston and slidable in said compensator piston and said guide, a spring within said stem and bearing against the closed end of said cylinder to extend said stem, a hydraulic liquid filling said cylinder to a level above said compensator piston, an orifice valve in said shock absorbing piston permitting restricted flow of hydraulic liquid during descent of said shock absorbing piston in said cylinder, a check valve in said shock absorbing piston permitting relatively unrestricted flow of hydraulic liquid during upward movement of said shock absorbing piston in said cylinder, a check valve in said compensator piston for relatively unrestricted downward flow of hydraulic liquid therethrough thereby to maintain the region below said compensator piston completely full of hydraulic fluid.

5. A shock absorber, as defined in claim 4, which further comprises: an inverted cylinder closed at its upper end and secured to the protruding end of said stem, said inverted cylinder slidably receiving the first mentioned cylinder, means for securing one of said cylinders in a fixed position, a slide bearing formed by the end surface of

the other cylinder, and a slide plate engageable with said slide bearing.

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ARTHUR L. LA POINT, *Primary Examiner.*

H. BELTRAN, *Assistant Examiner.*

Sept. 2, 1969 O. E. SEAY 3,464,366

HYDRAULICALLY DAMPENED RAILWAY TRUCK BOLSTER

Filed Sept. 29, 1966 4 Sheets-Sheet 1

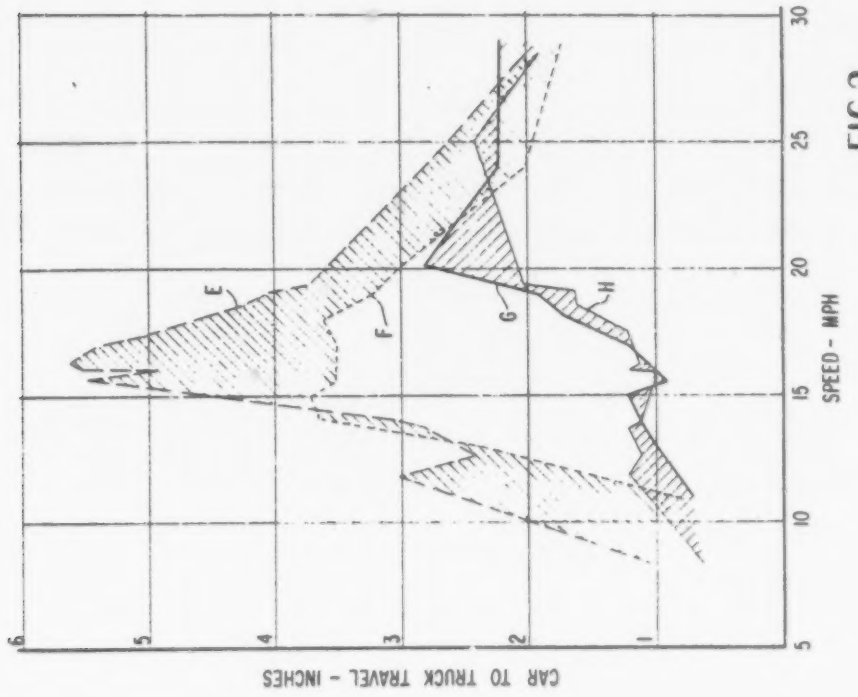

FIG 2

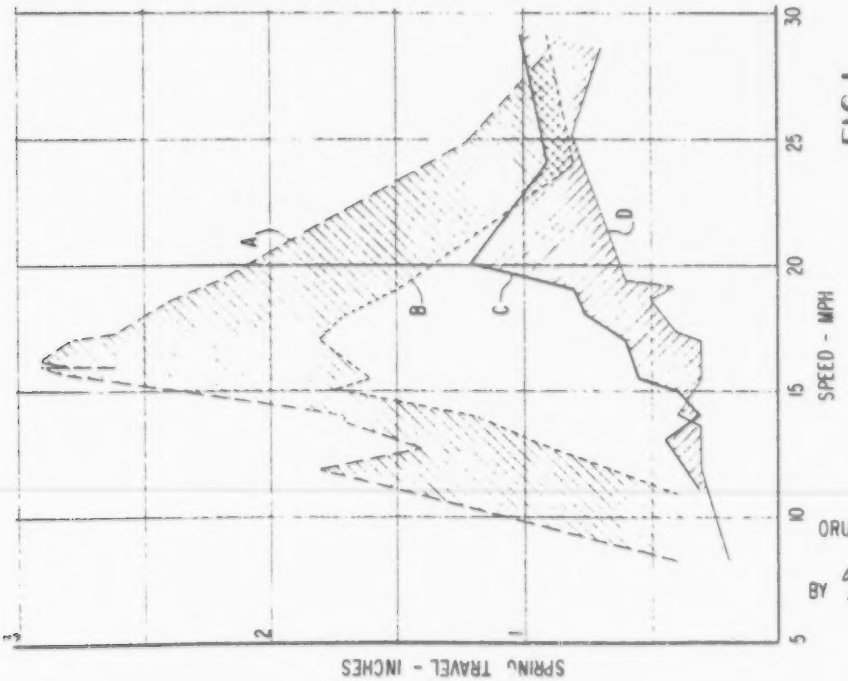

FIG 1

INVENTOR
ORUM E. SEAY
BY
ATTORNEYS

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HYDRAULICALLY DAMPENED RAILWAY TRUCK BOLSTER

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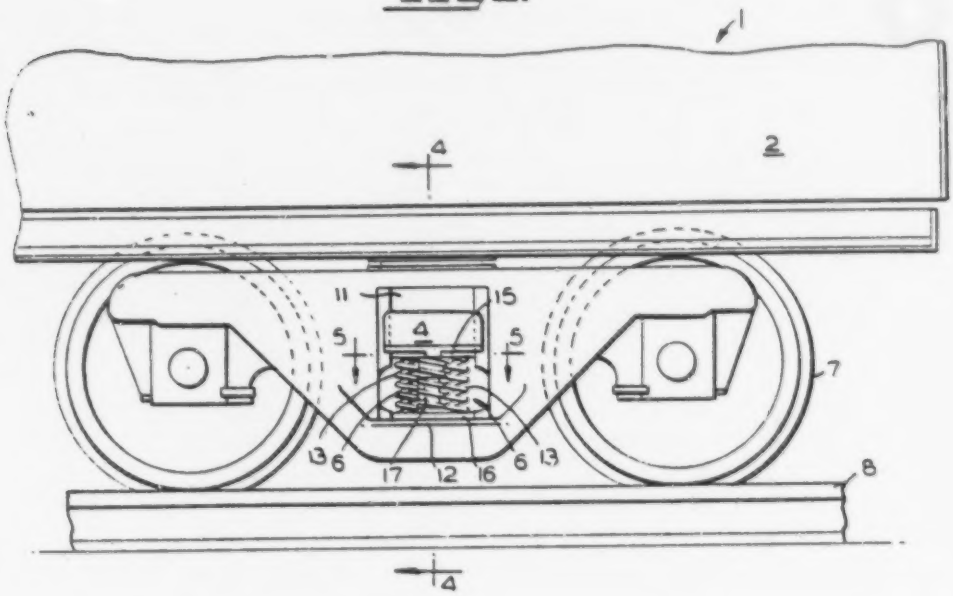
FIG 3.



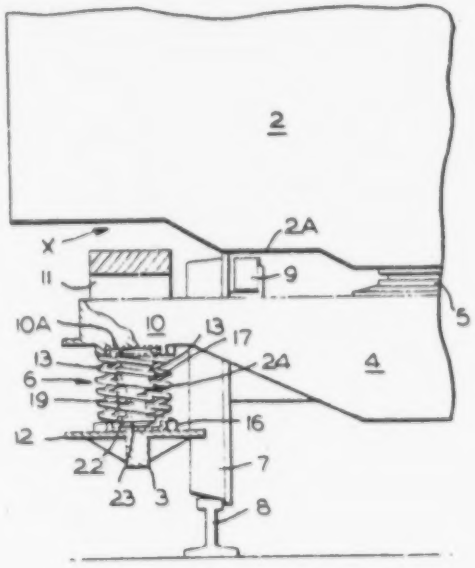
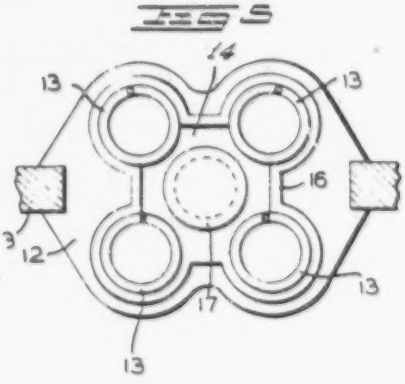


FIG 4.

FIG 5



INVENTOR
ORUM E SEAY

BY
Burns, Doane, Benedict, Swecker & Mathis
ATTORNEY

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HYDRAULICALLY DAMPENED RAILWAY TRUCK BOLSTER

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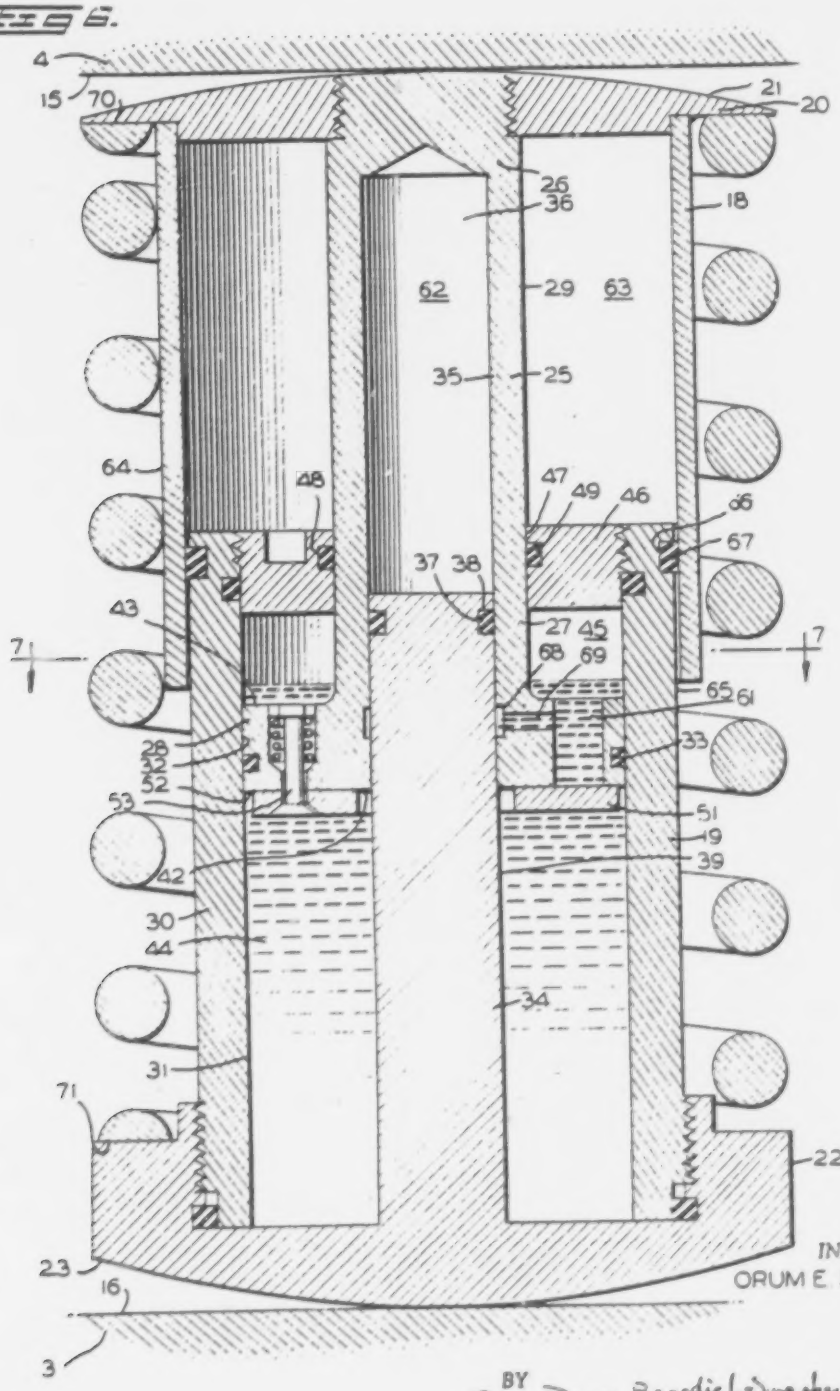
Fig 6.



INVENTOR
ORUM E. SEAY

BY Burns, Doane, Benedict, Swecker & Mathis
ATTORNEY

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HYDRAULICALLY DAMPENED RAILWAY TRUCK BOLSTER

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FIG 7.

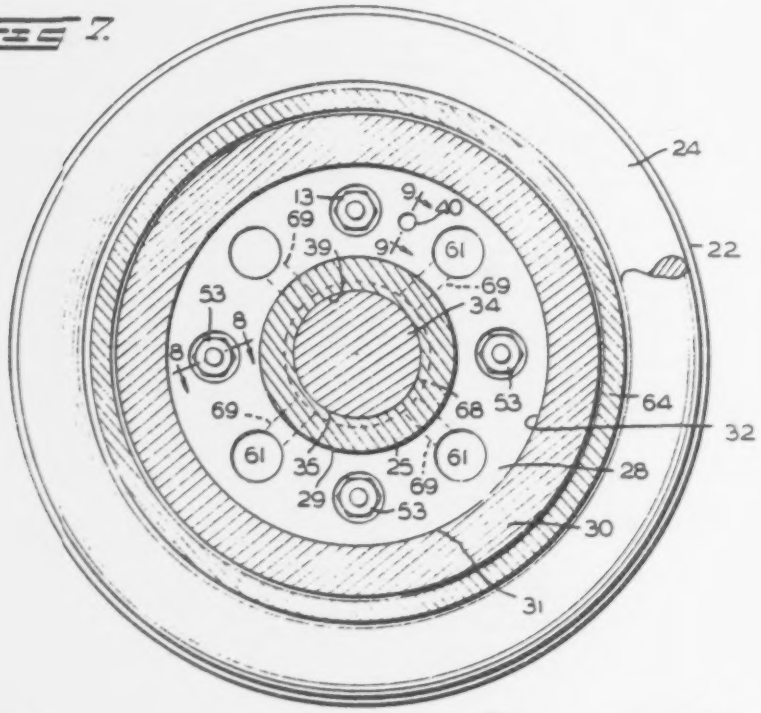


FIG 8.

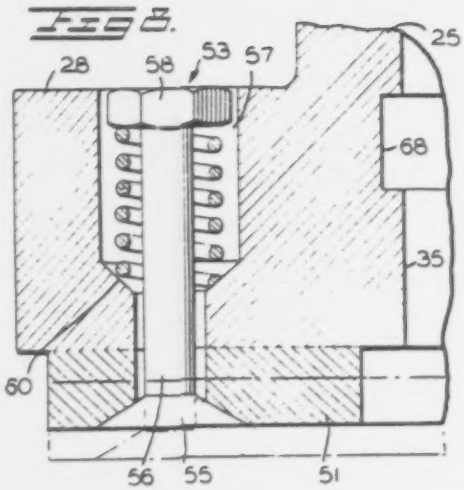
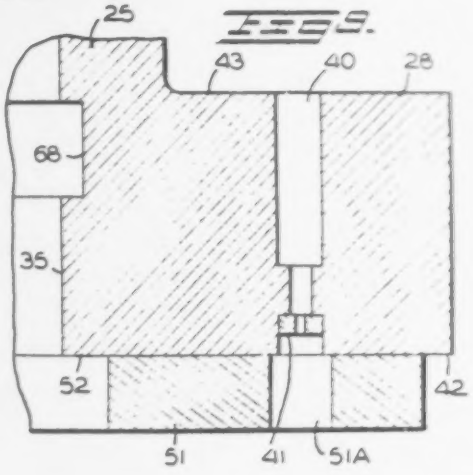


FIG 9.



INVENTOR
ORUM E. SEAY

BY Burns, Doane, Swecker & Mathis
ATTORNEY

United States Patent Office

3,464,366

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HYDRAULICALLY DAMPENED RAILWAY TRUCK BOLSTER

Orum E. Seay, Duncan, Okla., assignor to Halliburton Company, Duncan, Okla., a corporation of Delaware

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Int. Cl. B61f 5/06, 5/12

U.S. Cl. 105—197 5 Claims

ABSTRACT OF THE DISCLOSURE

A shock-absorbing assembly interposed between the bolster and truck of a railway car and including a hydraulic shock-absorber freely nested between pocket defining shock-absorbing coil springs. Each end of the hydraulic shock absorber is disposed in disconnected stress-relieving engagement with either a truck or bolster portion.

General background of invention

This invention relates to a system for stabilizing railway cars against lateral sway. In particular, it relates to such a system employing a unique disposition of hydraulic shock absorbing units between the truck and bolsters of railway cars and to the novel structure of the shock absorber unit itself.

In recent years, manufacturers of railway cars have produced cars having a greater length and height than those earlier utilized. These changes in size of railway cars have tended to raise their center of gravity and increase their tendency to sway. Such sway characteristics are troublesome in that they often induce sufficient car movement to enable the wheels of a railway car to leave the track and thereby cause train derailment.

Of particular concern has been the propensity for railway cars to undergo maximum sway at the relatively low operating speeds employed in railway switching and loading yards. At such low speeds, it has been found that many railway cars, provided with conventional spring clusters between its trucks and bolsters, reach a peak of sway movement. It is generally believed that this maximum sway condition results when a railway car undergoes movement conforming to its nautral frequency of motion, as induced by the relationship between car velocity and track irregularities.

Where the peak, railway car sway condition occurs at a sustained operating speed, the sway problem becomes so pronounced as to often result in car derailment. However, where the peak sway condition occurs as a portion of the normal acceleration cycle, the period of maximum sway is transitory and far less likely to induce car derailment or serious sway conditions. However, as will be readily apparent, even where the maximum sway condition is transitory or short lived, it is desirable to minimize car movements.

To some degree excessive railway car sway which is encountered in operation is a direct consequence of the conventional structural arrangement employed to resiliently support railway cars.

In a conventional freight car suspension arrangement, each end of the car is supported by a truck and bolster assembly. The truck carries the railway car wheels while the bolster is pivotally mounted to the underside of the railway car body. Coil spring groupings at each end of the truck are interposed between the underside of the bolster and an upwardly facing portion on one side of the truck.

In this way, the railway car bolster serves as a cross beam serving to resiliently transfer the weight of the railway car to the railway car truck. However, the conventional pivot connection between the railway car and its bolster is such as to allow some limited pivotable movement of the car relative to the bolster. Thus the car body can undergo some limited swaying movement which is not controlled by the springs supporting the bolster. Thus excessive spring movement will often tend to induce free movement of the railway car body relative to the bolster which is not adequately controlled by the bolster springs and which may be of a sufficient amplitude to induce derailment.

Of additional concern is the normal lateral freedom of movement of a bolster relative to its associated truck. Although limited in extent, this movement is sufficient to impose severe lateral force on the suspension system.

A variety of hydraulic shock absorbing systems have been proposed for utilization in railway car stabilizing systems in an effort to minimize car movements. However, these shock absorbing arrangements have required special mounting connections so as to complicate their installation in present railway equipment.

It also must not be overlooked that a basic problem involved in stabilizing railway cars entails the severity of forces and dynamic loading variations which are imposed on their suspension components. Obviously a railway car carrying a load on the order of a hundred tons generates forces which are exceedingly difficult to accommodate. For this reason, shock asborbing devices for use in railway cars must be characterized by unusual structural ruggedness.

Objects and summary of invention

Particularly with respect to the new railway cars which are vulnerable to excessive sway phenomena it is an object of the present invention to provide a railway car movement stabilizing system and shock absorbing device which substantially reduce the degree of car sway and reduce or eliminate car derailment tendencies.

It is a further object of the invention to provide such an improved stabilizing system and device which reduce the extent of axially oscillating movement of railway car springs so as to reduce the amplitude of railway car body movement relative to the trucks of the railway car, i.e., relative to the track on which the car is traveling.

It is also an object of the invention to increase the speed at which maximum railway car sway conditions occur in response to track conditions to a speed above that normally employed in switching and loading yards.

It is also an object of the invention to provide a railway car shock absorber arrangement disposed between the bolster and truck of a railway car and which does not require special mounting arrangements to accommodate rotary movement of the truck relative to the car.

It is a related object of the invention to provide a shock absorber disposed between a railway car truck and bolster which is disconnected with either of these car components.

A further object of the invention is to provide an improved mounting arrangement for a railway car shock absorber wherein the problems associated with lateral car body movement relative to the shock absorber are minimized.

Yet another object of the invention is to provide a railway car shock absorbing structure which is continuously in precompressed engagement with railway car truck and bolster portions and which is nested within the conventional coil spring bolster mounting arrangement.

It is also an object of the invention to provide an improved railway car, hydraulic shock absorber including an arrangement for effectively stabilizing the movement of a piston of the shock absorber within an associated cylinder.

Yet another object of the invention is to provide an improved railway car, hydraulic shock absorber including air compression chambers which aid in restoring the piston and cylinder components to their normal positions, after they have been converged.

It is also an object of the invention to provide such an improved railway car shock absorbing structure including a unique passage arrangement which serves to prevent hydraulic fluid from being transferred into air compression chambers of the shock absorber body.

In order to accomplish some of the principal objects heretofore noted, there is presented through this invention a basic railway car stabilizing system comprising shock absorbing means having mutually and yieldably convergeable ends. Means provide rolling and sliding contact between one end of this shock absorbing means and one portion of a railway car while other means provide rolling and sliding contact between the other end of the shock absorbing means and another portion of the railway car.

A particularly advantageous embodiment of the invention involves this basic system wherein the shock absorbing means is disposed in a pocket defined by a plurality of axially displaced, coil spring units.

Another particularly advantageous embodiment of the invention involves the basic system including precompressed resilient means which maintain the shock absorbing means in continuous, resiliently biased, compressive engagement with relatively movable portions of the railway car suspension system.

Optimum system advantages are derived where the shock absorbing means is nested between spaced coil springs and disposed in precompressed, resiliently biasing engagement with railway car portions, with opposite ends of the shock absorbing means each being in rolling and sliding engagement with a railway car portion. In this optimum embodiment of the invention, the shock absorbing means is preferably disposed in engagement with an under portion of an end of a railway car bolster and an upwardly facing portion of a railway car truck, with such a shock absorbing mounting arrangement being provided between each end of each bolster of the railway car and its associated truck portion.

A further and independently significant facet of the invention pertains to a shock absorbing structure which is characterized by a piston stabilizing pin which projects longitudinally of piston means. A longitudinally extending, stabilizing passage is formed in the piston means and telescopingly receives the stabilizing pin. In this combination, the stabilizing pin is disposed in slidable and stabilizing engagement with the stabilizing passage continuously throughout the movement of the piston means.

In a preferred and particularly advantageous form of this shock absorber structure, passage means are carried by the piston means which provide fluid communication between the low pressure end of the piston means and the interface between the stabilizing passage and the stabilizing pin.

Uniquely important advantages are derived from the basic structure of the improved shock absorber when it includes a first wall defining a spherical segment facing outwardly of the shock absorber and a second wall defining a spherical segment facing outwardly of the shock absorber and a second wall defining a spherical segment facing outwardly of the shock absorber and away from the first wall.

Drawings

In describing the invention reference will be made to a preferred embodiment as illustrated in the appended drawings.

In the drawings:

FIGURE 1 graphically illustrates performance curves comparing the maximum spring travel characteristics of a conventional railway car suspension system and the improved suspension system of the present invention;

FIGURE 2 graphically illustrates performance curves comparing the degree of maximum, railway car body to truck, movement for standard railway cars and railway cars including the improved stabilizing system of the present invention;

FIGURE 3 is a fragmentary, schematic view of an end of a railway car illustrating structural relations between a shock absorber, coil springs, railway car truck, and railway car bolster as disposed in accordance with the invention;

FIGURE 4 provides a fragmentary transverse sectional view through the shock absorbing arrangement of the FIGURE 3 stabilizing system;

FIGURE 5 is a fragmentary sectional view of the FIGURE 3 assembly, looking downwardly on the hydraulic shock absorber and its nesting pocket as defined by a plurality of axially displaced, coil springs;

FIGURE 6 is an enlarged, sectioned elevational view of the shock absorber employed in the FIGURE 3 assembly;

FIGURE 7 is a transverse sectional view of the FIGURE 6 shock absorber as viewed along the section lines 7—7 of FIGURE 6;

FIGURE 8 is an enlarged sectional view of a check valve portion of the FIGURE 6 shock absorber as viewed along the section line 8—8 of FIGURE 7; and

FIGURE 9 is an enlarged sectional view of a restricted passage defining metering orifice included in the piston component of the FIGURE 6 assembly, as viewed along the section line 9—9 of FIGURE 7.

Overall stabilizing system

FIGURES 3, 4 and 5 illustrate a typical freight car 1 which has been modified to include the stabilizing system of the present invention.

Railway car 1, in a conventional fashion, includes a car body 2, a railway truck 3, a bolster 4, a pivot bearing 5, and spring and shock absorbing suspension means 6.

Truck 3 is conventional and supports four wheels 7. On each side of the truck two wheels are aligned in engagement with a rail 8 as shown in FIGURE 3. Bolster 4 is connected by the pivot bearing 5 to the underside of railway car 1. Pivot bearing 5, consistent with the usual degree of tolerances employed in fabricating railway cars, enables car body 2 to undergo limited swaying or pivoting movement transversely of the longitudinal median plane of the car. Thus, bolster 4, on each end of its top side, may carry a roller bearing 9 which may be spaced slightly beneath the underside of the car body 1. When the car body 2 rocks or sways laterally on the pivot bearing 5 relative to the bolster 4, its underside portion 2A will engage one of the roller bearings 9 so as to limit this rocking movement. The roller bearings 9 on each side of the bolster 4 serve to facilitate rotational movement of the bolster 4 about the generally vertical pivot axis of pivot bearing 5.

Bolster 4, at each end 10, is mounted for generally vertically guided, sliding movement in a truck aperture 11. Between the underside 10A of each end 10 of the bolster 4 and an upwardly facing base 12 at the lower end of the truck recess 11 is interposed the coil spring and hydraulic shock absorber assembly 6. As will be understood, this assembly is interposed between each end of each bolster of the railway car and its associated truck portion. Thus the car 1 is provided with four such assemblies 6, two carried by a truck at one end of the car and two carried by the truck at the other car end.

Each assembly 6 may comprise four coil springs 13 mounted in generally horizontal alignment with their axes being mutually parallel and parallel to the pivot axis of the pivot bearing 5. These four coil springs 13 have their longitudinal axes horizontally displaced so as to define a central pocket 14. Coil springs 13 may be mounted between upper and lower plates 15 and 16 in a conventional fashion in a manner generally consistent

with the coil spring and mounting plate arrangement featured on page 879 of the 1966 Car and Locomotive Cyclopedia, published by Simmons-Boardman Publishing Corporation of New York. As will be understood, many conventional suspension units employ more than four coil springs.

With this mounting arrangement, the lower plate 16, in essence, functions as an upwardly facing, planar wall portion of the truck 3, while upper plate 15 functions as a downwardly facing planar wall portion of the bolster 4. The manner in which the coil springs 13 and their associated mounting plates 15 and 16 are secured between the truck aperture base 12 and bolster end 10 is conventional in character and is illustrated, for example, on page 882 of the 1966 Car and Locomotive Cyclopedia.

As will be appreciated, the coil springs 13 may be installed without the associated mounting plates so as to directly engage the underside 10A of the bolster 10 and the base 12 of the truck recess 11 in the manner generally illustrated on page 818 of the 1966 Car and Locomotive Cyclopedia.

Mounted in the pocket 14, which is more or less peripherally defined by the coil springs 13, is a hydraulic, shock absorbing device 17. The hydraulic shock absorbing device includes an upper disposed, piston portion 18 which is telescopingly received within a lower disposed, cylinder portion 19. Piston and cylinder portions 18 and 19 are mounted in the pocket 14 with their axes of telescoping movement extending generally vertically, i.e., generally longitudinally of the pocket 14. The piston portion 18 carries an upper end wall 20. End wall 20 has an upwardly and axially facing face 21 in the form of a spherical segment disposed in rolling and tangential sliding engagement with the planar wall portion 15 of the truck 4. Cylinder 19 carries a lower end wall 22 of the shock absorber 17. End wall 22 includes a downwardly and axially facing spherical segment face 23 which is disposed in rolling and tangential sliding engagement with the upwardly facing planar wall portion 16 of the truck 3.

Preferably, the width, i.e., diameter, of each unit 17 corresponds substantially to the width or diameter of the coil springs 13. This facilitates the fabrication of an assembly 6 by merely replacing the center or fifth spring of a five-spring shock absorbing unit, as shown on page 879 of the 1966 Car and Locomotive Cyclopedia, with the shock absorber 17 of the present invention.

The width of the horizontal spaces between adjacent coil springs 13 is less than the width of the shock absorber 17. Thus the shock absorber 17 is prevented by the coil springs from moving laterally out of the pocket 14. As will be appreciated, the pocket 14, in order to restrain the hydraulic shock absorber 17 against lateral movement, requires a plurality of at least three, pocket periphery defining, coil springs 13. However, it should be here noted that the invention may be practiced with a shock absorber unit 17 being used to replace any of the springs 13. Where the unit 17 replaces an outside spring 13, it will be retained in place by conventional spring retaining structures such as the flanges of mounting plates illustrated on page 879 of the 1966 Car and Locomotive Cyclopedia.

The shock absorber 17 is disconnected with either the bolster 4 or the truck 3, being disposed only in rolling and tangential sliding engagement with these car components. A coaxial and peripherally disposed, precompressed coil spring 24 serves to bias the spherical segments 21 and 23 into resiliently compressive engagement with the wall portions 15 and 16 respectively. Thus, as illustrated, coil spring 24 urges the shock absorber end walls 20 and 22 mutually outwardly and maintains these end walls in mutually and yieldably convergeable relation.

In this fashion, each of the four shock absorbers 17 associated with the car 1 exerts a resilient lifting force against the underside of each end of each of the two bolsters 4 associated with the car 1. When a bolster 4 undergoes lateral movement relative to the truck 3, as permitted by the conventional loose, sliding mounting of the bolster end 10 in the truck recess 11, minimized horizontal thrust is imposed on the shock absorber 17 owing to the rolling and tangential, sliding contact between the upper and lower ends of the shock absorber 17 and the bolster and truck respectively. The generally point-like contact between the spherical segments enables stress relieving sliding movement to occur between the segments and the planar wall portions which they contact. The rolling contact between the segments and planar wall portions enables each shock absorber to pivot in response to the imposition of laterally directed force. This pivoting prevents the piston of the shock absorber from being jammed laterally against its cylinder so as to impede its downward movement. Excessive pivoting and/or sliding of each shock absorber 17 is prevented by the restraining influence of the inner, pocket defining, portions of the coil springs 13.

Structure and operation of shock absorber

FIGURES 6 through 9 illustrate structural details of the shock absorber 17.

As previously noted, shock absorber 17 comprises a piston component 18 and a cylinder component 19.

Piston component 18 includes a generally tubular piston rod 25 having a closed upper end 26, an open lower end 27 and an annular piston head 28. Piston rod 26 is cylindrical in character so as to have a cylindrical outer surface 29.

Cylinder 19 includes a cylindrical wall 30 providing an inner wall 31 having a circular cross-section which slidably and sealing engages the outer circularly and matingly cross-sectioned periphery 32 of the annular piston 28. Annular piston 28 may carry an elastomeric or metallic piston ring 33 to positively insure slidable and sealing engagement between the piston periphery 32 and the cylinder wall 31.

Cylinder 19 has a closed lower end defined by lower end wall 22 of the shock absorber 17. As illustrated in FIGURE 6, end wall 22 may be threadably connected to cylindrical wall 30 of cylinder 19 so as to provide the closed lower end of the cylinder. As previously noted, lower end wall 22 includes a spherical segment surface 23 having a radius which is coaxial with the central axis of the cylinder wall 30 of the cylinder 19 and the piston 18.

A stabilizing pin 34 of generally uniform circular cross-section projects axially upwardly from the end wall 22 toward the piston 18.

Piston rod 25 includes an inner surface 35 having a generally axially uniform, circular, cross-sectional configuration. Surface 35 defines a central, coaxial, and longitudinally extending passage 36 having an open lower end and a closed upper end.

Passage 36 continuously, telescopingly and slidably receives the upwardly projecting pin 34. Sealing and slidable engagement between pin 34 and the passage 36 may be promoted by an annular gasket 37 carried in an annular recess 38 on the upper end of the pin 34. Wall 35 of passage 36 is disposed in slidable, mating engagement with the outer periphery 39 of the pin 34 so as to positively stabilize the piston head 28 for axially centered, sliding movement within the cylinder 19. Thus, skewing of the piston 18 relative to the cylinder 19 is effectively prevented at all times.

Piston head 28 includes at least one longitudinally extending flow impeding or flow restricting passage 40. A replaceable flow metering orifice 41 may be press-fitted or threaded into the passage 40 as generally shown in FIGURE 9. Passage 40 provides fluid communication between the high pressure end 42 of the piston head 28 and the low pressure end 43 of this piston. As shown in FIGURE 6, high pressure end 42 is disposed in engage-

ment with and faces a body 44 of hydraulic fluid such as oil, while low pressure end 43 faces an at least partially unoccupied cavity 45 designed to receive fluid which passes through the restricted passage 40 from the fluid body 44.

The upper end of cavity 45 may be closed by an annular rim 46 projecting radially inwardly from the upper end of the wall 30. As shown in FIGURE 6, rim 46 may be threadably secured to the wall 30 and includes a central, generally cylindrical, aperture defining surface 47 disposed in slidable and sealing engagement with the outer periphery 39 of the piston rod 25. Cylindrical surface 47 may include an annular recess 48 in which is inserted a conventional annular gasket 49 to promote slidable and sealing engagement between the rim 46 and the piston rod 25.

As will be appreciated, the passage 40 is designed to impede converging movement of the piston head 28 into the cylinder 19, i.e., downward movement of the piston head 28 as shown in FIGURE 6. This impeded movement serves to absorb compressive energy imposed on the upper end of the piston 18 by movement of the railway car body and its associated bolster 4.

Rapid return or upward movement of the piston head 28 is facilitated by check valve means 50 carried by the piston head 28.

Check valve means 50 comprises an annular valving plate 51 supported on the under or high pressure end of the piston 28. Valving plate 51 is biased upwardly into mating engagement with a radially extending valve seat 52 by a plurality of spring mechanisms 53.

Each spring mechanism 53, as shown in FIGURE 8, includes a bolt-like member 54 having a lower head 55 secured to the plate 51 and a shank 56 which passes upwardly through a piston head passage 57 to terminate in an enlarged upper end 58. Upper end 58 may be defined by a conventional nut threadably secured to the shank 56. A coil spring 59 encircles the shank 56 and at its upper end, engages the underside of the nut 58 and at its lower end, an annular seat 60 formed in the passage 57.

One or more check valving passages 61, as shown in FIGURES 6 and 7, extend longitudinally of and through the piston head 28 so as to provide fluid communication between the high and low pressure ends of the piston head. When valve plate 51 is in its upwardly spring-biased position shown in FIGURE 6, closing the lower end of the passages 61, an upward flow of fluid from the body 44 through the passages 61 is prevented or at least effectively minimized. Thus, on the downward stroke of the piston head 28, fluid flow is governed by the flow restricting orifice 41. As shown in FIGURE 9, plate 51 includes an aperture 51A providing continuous fluid communication between passage 40 and fluid body 44.

On the upward or return stroke of the piston head 28, fluid which has been transferred into the cavity 45 may return rapidly to the passage 44 by flowing downwardly through the passages 61 and moving the plate 51 out of valving engagement with the radial face 52 by overcoming the biasing effect of the coil springs 53. This, of course, enables the piston head 28 to restore itself in a rapid fashion.

The restoring of the piston head 28 is also facilitated by a pair of coaxial air compression chambers formed as unitary components of the shock absorber 17.

One such air compression chamber 62 is defined by the piston rod 25 and the stabilizing pin 34. Thus, compression chamber 62 comprises the upper end of the stabilizing pin receiving passage or stabilizing passage 36 defined by the interior of the piston rod 25. On the downward or compression stroke of the piston 18, air within the chamber 62 is compressed and the energy of this compressed air facilitates the restoration of the piston to its upper level.

The other air compression chamber of the apparatus comprises an annular chamber 63 which encircles the piston rod 25 and is disposed axially between the cylinder rim wall 46 and the spherical segment defining, end wall 20.

As illustrated, wall 20 may be threadably connected to the upper end of the stem 25. A cylindrical shroud 64 is carried by the wall 20 and projects axially downwardly into slidable and sealing engagement with the outer cylindrical periphery 65 of the cylinder 19. Cylinder 19, on its outer periphery and in an annular groove 66, may carry an annular gasket 67 to promote sealing and sliding engagement between the shroud 64 and the cylinder periphery 65. Thus, on the compression or downward stroke of the piston 18, air within the compression chamber 63 is compressed and the energy of this compressed air also serves to facilitate the restoration of the piston 18 to its uppermost location.

As will be appreciated, it is undesirable that fluid within the hydraulic body 44 migrate into the air chambers 62 or 63. The likelihood of such migration occurring is most acute with respect to the central air chamber 62.

To avoid the likelihood of migration of hydraulic fluid into the chamber 62 occurring, a unique high pressure fluid, scavenging system is incorporated between the piston stabilizing pin 34 and the piston head 28. This scavenging system comprises an annular and radially outwardly extending recess 68 formed in the surface 35 radially adjacent the piston head 28. A passage 69 extends radially from each of the check valve passages 61 to the annular recess 68. The annular recess 68 and the radial passages 69 provide fluid communication between the lower pressure chamber 45, and the interface between the piston head 28 into stabilizing pin 34. Thus, fluid from the high pressure hydraulic body 44 which migrates between the mating faces of the piston head 28 and the stabilizing pin 34 will be transferred through the recess 68 and passages 69 and 61 to the low pressure oil chamber 45, rather than to the air chamber 62.

As previously described, and as illustrated in greater detail in FIGURE 6, the lower annular surface 70 of the wall 20 outside of the shroud 64 and the upper annular surface 71 of the end wall 22 outside of the cylinder wall 19 are engaged by upper and lower ends respectively of a coil spring 24. Coil spring 24 tends to restore the piston 18 to its upper position shown in FIGURE 6 after the piston component 18 has been converged with the cylinder component 19, i.e., moved downwardly.

The shock absorbing assembly 17 is installed with the spring 24 compressed, i.e., the wall means 15 of the bolster 4 depresses the upper end 21 of the piston component 18 sufficiently to precompress the spring 24 so that the spherical segment surfaces 21 and 23 are maintained in precompressed, tangential engagement with the wall portions 15 and 16 respectively.

The rolling and sliding engagement between each end of the shock absorber 17 and a portion of the railway car, coupled with the continuously pin stabilized piston, assures a uniquely effective operation of the shock absorber 17.

Lateral thrust forces imposed by the railway car body 2, through the bolster 4, to the shock absorber 17, induce rolling movement of the shock absorber 17, rather than tending to skew or twist the piston head 28 within the cylinder wall 30. Any such skewing tendency as might be present is effectively offset by the piston movement stabilizing pin 34. Rapid restoration of the shock absorber, subsequent to a compression stroke, is facilitated by the coil spring 24 operating in conjunction with the air compression chambers 62 and 63.

The continuously effective character of the air compression chamber 62 is assured by the scavenging system defined by the recess 68 and the passage means 69 and 61. This scavenging system, of course, also prevents undesired loss of hydraulic fluid or oil from the main oil body 44.

The continuously effective compressive engagement of each of the four shock absorbers 17 with a bolster portion of the railway car 1 insures that movement of each end of each bolster of the railway car is continuously dampened without interfering with pivotable movement of the bolster 4 about its pivot mount 5.

Improvement in railway car stabilization obtained through the invention

FIGURES 1 and 2 graphically compare railway car stabilization as achieved by conventional spring suspension systems and as achieved with a hydraulic shock absorber structure and shock absorber disposition in accordance with the present invention.

Curves A and B of FIGURE 1 depict the maximum changes in axial length of the coil springs 13 that occur in standard railway cars lacking the shock absorber structure and shock absorber mounting of the present invention.

These tests were performed on curved track sections with curve A depicting maximum movement of the coil springs located on the ends of bolsters disposed on the outside of the curved track. Curve B depicts the maximum movement of coil springs in engagement with bolsters on the inside track of the curve.

Curves C and D depict the maximum extent of axially oscillating movement of coil springs when the car suspension system has been modified by the incorporation of the shock absorber structure and mounting arrangement previously described. Curve C graphically illustrates maximum changes in axial dimension of coil springs in engagement with bolsters on the outer rail side of the track. Curve D depicts maximum axial spring movement for springs engaging bolsters on the inner rail side of the curve.

As will be apparent by reference to the curves of FIGURE 1, with a conventional suspension system, maximum spring travel during the test was measured to be of the order of about 2.9 inches. Where the suspension system was modified by the addition of the shock absorber assembly previously described, this spring travel was reduced to about 1.2 inches.

FIGURE 2 graphically illustrates comparisons of the maximum relative movement which occurs between a railway car body and one of its associated trucks with respect to standard railway car suspension systems and suspension systems modified by the incorporation of shock absorber arrangement of this invention.

Curves E and F of FIGURE 2 were derived from the operation of railway cars having standard suspension systems and illustrate maximum relative movement between car bodies and car trucks. This movement is the general degree of relative movement between car body and car truck which occurs in the area X of FIGURE 4. Curve E depicts this movement which occurs on the railway car on the outer rail side of a track, while curve F depicts the movement which occurs on the inner rail side of a track.

Curves G and H depict the degree of maximum movement of a railway car body relative to a railway car truck where the car has been provided with the shock absorber structure and mounting arrangement of this invention. Curve G depicts maximum car to truck movement on the outer rail side of a curved track, while curve H depicts maximum car to truck movement on the inner side of a rail track.

As FIGURE 2 illustrates, with a conventional car suspension system, maximum car to truck movement, i.e., lateral sway, was on the order of 5.6 inches. Where the suspension system was modified by the structure and mounting arrangement of the shock absorber assemblies of the present invention, this sway movement was reduced in half, i.e., to about 2.8 inches.

This reduction in sway of car movement significantly minimizes the chances of car derailment. Indeed, during the test which produced the results reflected in the charts of FIGURES 1 and 2, wheel lifting on cars provided with the shock absorber system of this invention was not observed. However, wheel lifting with the standard car suspension systems was observed at several points.

It is also significant to note that with cars modified by the addition of the shock absorbing system of the present invention, the speed at which maximum sway occurs was raised from about sixteen miles per hour to about twenty miles per hour. This shift of the critical sway speed is significant in that most railway cars operate in railway yards at speeds often in the vicinity of fifteen or sixteen miles per hour. Thus, in shifting the critical sway speed to a higher level above the speed normally encountered in yard operations, the likelihood of derailments in railway yards has been substantially reduced. As has been previously noted, the occurrence of maximum sway tendencies at a higher speed, which cars attain during acceleration on open track, is not nearly as serious from the standpoint of inducing derailment.

It should also be noted that the suspension system of this invention reduces substantially the divergence between peak spring travel for springs at the inner and outer bolster ends. This is shown in FIGURE 1 by comparing the thickness of the two shaded zones at the peak sway points. Similarly, by referring to FIGURE 2, it will be seen that the improved suspension system reduces the divergence between peak car body movement, relative to a truck, as measured at the inner and outer rail car body sides.

Other comparative tests conducted with the standard cars and cars provided with the stabilizer systems of this invention have produced data indicating that this stabilizing system will effect sway reductions up to 69%, with average sway reductions often being measured on the order of 60%. Even with cars which did not normally tend to undergo heavy sway, the incorporation of the stabilizer system of this invention tended to reduce sway on the order of 28%.

In describing the invention reference has been made to a preferred shock absorber structure and installation embodiments. However, those skilled in the railway art and familiar with the disclosure of the invention may well recognize additions, deletions, substitutions or other modifications which would fall within the purview of the invention as defined in the appended claims.

I claim:

1. A railway car stabilizing device comprising:

at least three coil spring means having mutually displaced longitudinal axes, said axes being spaced about a shock absorber receiving pocket;

shock absorber means disposed in said pocket;

a downwardly facing wall portion carried by a bolster of a railway car;

an upwardly facing wall portion carried by a truck of said railway car associated with said bolster;

said shock absorber means being disposed in said pocket in abutting engagement with said downwardly and said upwardly facing wall portions and being restrained from lateral movement out of said pocket by said plurality of coil springs, with each adjacent pair of said plurality of springs being spaced a distance less than the width of said shock absorber means;

said shock absorber means comprising an assembly including piston means disposed in slidable stress relieving engagement with one of said bolster and truck wall portions;

said assembly further including cylinder means telescopingly receiving said piston means for hydraulically impeded movement in response to convergence of said wall portions of said truck and bolster, with said cylinder means being disposed in slidable stress relieving engagement with the other of said bolster and truck wall portions; and

said bolster wall portion being retractably convergible with said truck wall portion and operable, in response to convergence with said truck wall portion, to telescopingly contract said shock absorber means; and

said coil spring means being operable to urge said bolster wall portion, when converged with said truck wall portion, away from said truck wall portion and permit said shock absorber means to telescopingly extend.

2. A railway car stabilizing device comprising:

cylinder means;

piston means telescopingly received within said cylinder means;

restricted passage means in said piston means providing fluid communications between each of opposite axial ends of said piston means;

said piston means having a high pressure end in engagement with a body of fluid and a low pressure end facing a cavity intended to receive fluid which passes from the high pressure end of said piston means through said restricted passage means;

a piston stabilizing pin projecting longitudinally of said piston means;

a longitudinally extending stabilizing passage formed in said piston means and telescopingly receiving said stabilizing pin;

said stabilizing pin being disposed in slidable and stabilizing engagement with said stabilzing passage continuously throughout the movement of said piston means;

mutually and yieldably convergible ends carried by said cylinder means and said piston means;

means providing rolling and sliding contact between one of said ends and a bolster portion of a railway car; and

means providing rolling and sliding contact between the other of said ends and a truck portion of said railway car; and

a plurality of spaced spring units disposed externally of and peripherally confining said telescopingly assembled cylinder means and piston means, with said plurality of spring units extending between and engaging said bolster and truck portions;

said bolster portion being retractably convergible with said truck portion and operable, in response to convergence with said truck portion, to telescopingly contract said cylinder means and piston means; and

said spring units being operable to urge said bolster portion, when converged with said truck portion, away from said truck portion and permit said cylinder means and piston means to telescopingly extend.

3. A railway car stabilizing device comprising:

a cylinder;

a piston telescopingly received within said cylinder;

restricted passage means in said piston providing fluid communications between each of opposite axial ends of said piston;

a piston stabilizing pin having an axially uniform circular cross-section projecting longitudinally of said piston;

a longitudinally extending stabilizing passage having a circular cross-section formed in said piston. and having a closed end and an open end telescopingly receiving said stabilizing pin;

said stabilizing pin being disposed in slidable and stabilizing engagement with said piston continuously throughout the movement of said piston;

a first end wall connected with said piston and defining a spherical segment facing axially outwardly of said piston;

a second end wall connected with said cylinder and defining a spherical segment facing axially outwardly of said cylinder and away from said first end wall; the spherical segments of said first and second end walls having axially aligned radii which are axially aligned with the central axis of said piston;

a first, sealed, air cushioning chamber defined by said stabilizer pin and said closed end of said stabilizing passage;

a cylinder shroud carried by said piston disposed in sealing and telescoping engagement with the outer periphery of said cylinder and defining a second sealed, air cushioning chamber axially adjacent one end of said cylinder;

a coil spring extending coaxially about said shroud and said cylinder, said spring being in abutting engagement with said upper and lower end walls;

at least one check valve carried by said piston and openable to permit fluid flow from said low pressure end of said piston to the high pressure end thereof;

at least three coil spring units having mutually displaced longitudinal axes, said coil spring units being spaced about and defining a pocket;

a downwardly facing planar, wall portion carried by a bolster of a railway car; and

an upwardly facing, planar wall portion carried by a truck of said railway car associated with said bolster;

said cylinder and piston being disposed in said pocket in abutting engagement with said downwardly and said upwardly facing wall portions and being restrained from lateral movement out of said pocket by said plurality of coil springs, with each adjacent pair of said plurality of springs being spaced a distance less than the width of said assembled piston and cylinder;

said spherical segment of said first end wall providing rolling and sliding contact between said piston means and said planar wall portion of said bolster; and

said spherical segment of said second end wall providing rolling and sliding contact between said cylinder and said planar wall portion of said truck;

each of said planar wall portions being disposed in tangential contact with its respectively associated spherical segment;

a plurality of spaced spring units disposed externally of and peripherally confining said telescopingly assembled cylinder and piston, with said plurality of spring units extending between and engaging said planar wall portions of said bolster and truck;

said bolster wall portion being retractably convergible with said truck wall portion and operable, in response to convergence with said truck wall portion, to telescopingly contract said cylinder and piston;

said spring units being operable to urge said bolster wall portion, when converged with said truck wall portion, away from said truck wall portion and permit said cylinder and piston to telescopingly extend.

4. A railway car stabilizing device comprising:

shock absorbing means having mutually and yieldably convergible ends;

means providing rolling and sliding contact between one end of said shock absorbing means and a bolster portion of a railway car;

means providing rolling and sliding contact between the other end of said shock absorbing means and a truck portion of said railway car;

precompressed resilient means maintaining said shock absorbing means in continuous, resiliently biasing, engagement with each of said portions of said railway car; and

a plurality of spaced spring units disposed externally of and peripherally confining said shock absorbing means and extending between and engaging said bolster portion and truck portion;

said shock-absorbing means comprising piston means connected with one of said mutually convergible ends and cylinder means connected with another

of said mutually convergible ends, with said cylinder means telescopingly receiving said piston means;

said bolster portion being retractably convergible with said truck portion and operable, in response to convergence with said truck portion, to telescopingly contract said shock absorber means; and

said spring units being operable to urge said bolster portion, when converged with said truck portion, away from said truck portion, and permit said shock absorber means to telescopingly extend.

5. A railway car stabilizing system having apparatus between each end of each bolster of said car and an underlying portion associated therewith, said apparatus comprising:

cylinder means;

piston means telescopingly received within said cylinder means;

restricted passage means providing fluid communications between each of opposite axial ends of said piston means;

said piston means having a high pressure end in engagement with a body of fluid and a low pressure end facing a cavity intended to receive fluid which passes from the high pressure end of said piston means through said restricted passage means;

at least three coil spring units having mutually displaced longitudinal axes, said coil spring units being spaced about and defining a pocket;

said cylinder means and piston means being disposed in said pocket, externally of said spring units;

said piston means having an upwardly facing end wall;

said cylinder means having a downwardly facing end wall;

means providing rolling and sliding contact between said upper end wall and an under portion of a bolster of a railway car;

means providing rolling and sliding contact between said lower end wall and a truck portion of said railway car associated with said bolster; and

pre-compressed resilient means between and engaging said upper and lower end walls and maintaining said walls in compressive, elastically yieldable engagement with said bolster portion and truck portion;

said bolster portion being retractably convergible with said truck portion and operable, in response to convergence with said truck portion, to telescopingly contract said cylinder means and piston means; and

said spring units being operable to urge said bolster portion when converged with said truck portion, away from said truck portion, and telescopingly extend said cylinder means and piston means.

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ARTHUR L. LA POINT, Primary Examiner

HOWARD BELTRAN, Assistant Examiner

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